

CHAPTER

11

INLAND
RAIL 

Biodiversity

NORTH STAR TO NSW/QUEENSLAND BORDER ENVIRONMENTAL IMPACT STATEMENT

 ARTC

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11. Biodiversity

11.1 Scope of chapter

The scope of this chapter is to assess potential biodiversity impacts from the construction and operation of the North Star to NSW/Queensland Border project (the proposal) and, where required, identify feasible and reasonable mitigation measures.

The structure and content of the report has been designed to address the *Biodiversity Conservation Act 2016* (NSW) (BC Act) and Biodiversity Assessment Method (BAM) while still assessing matters of national environmental significance (MNES) in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and other relevant regulatory provisions. Only MNES that are listed in the **Secretary's Environmental Assessment Requirements (SEARs)** as EPBC Act controlling provisions are considered in this report (i.e. listed threatened species and communities). The report will also address offset requirements and inform the feasibility of the proposal accordingly. Further details on the assessment approach are in Section 11.4.4.

Appendix B: Biodiversity Technical Report constitutes the Biodiversity Development Assessment Report that is a requirement as specified by SEARs.

11.2 Secretary's Environmental Assessment Requirements

This chapter has been prepared to address the SEARs as shown in Table 11.1.

TABLE 11.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS COMPLIANCE

	Item 5: Biodiversity
Desired performance outcome	<p>The project design considers all feasible measures to avoid and minimise impacts on terrestrial and Aquatic Biodiversity Technical Report.</p> <p>Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation.</p>
Current guidelines	<p><i>Biodiversity Assessment Method</i> (OEH, 2018)</p> <p><i>Policy and Guidelines for Fish Habitat Conservation and Management—Update 2013</i> (DPI, 2013)</p> <p><i>Threatened Species Survey and Assessment Guidelines</i> (DEC, 2004)</p> <p><i>Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (DPI, 2003)</p> <p><i>NSW Sustainable Design Guidelines Version 4.0</i> (TfNSW, 2017)</p> <p><i>Aquatic Ecology in Environmental Impact Assessment—EIA Guideline</i> (Smith, 2003)</p> <p>Freshwater threatened species distribution maps.</p>
SEARs requirement	EIS section
<p>Item 5.1</p> <p>The Proponent must assess biodiversity impacts in accordance with s7.9 of the <i>Biodiversity Conservation Act 2016</i> (BC Act), the <i>Biodiversity Assessment Method</i> (BAM) and be documented in a <i>Biodiversity Development Assessment Report</i> (BDAR).</p>	Section 11.4.4 and 11.10.1
<p>Item 5.2</p> <p>The BDAR must include information in the form detailed in s6.12 of the BC Act, cl6.8 of the <i>Biodiversity Conservation Regulation 2017</i> and the BAM.</p>	Section 11.4.4 and Appendix B: Biodiversity Technical Report
<p>Item 5.3</p> <p>The BDAR must be submitted with all digital spatial data associated with the survey and assessment as per Appendix 10 of the BAM.</p>	Digital spatial data associated with the survey will be provided with Appendix B: Biodiversity Technical Report
<p>Item 5.4</p> <p>The BDAR must be prepared by a person accredited in accordance with the <i>Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017</i> under s6.10 of the BC Act.</p>	Section 11.4.4 and Section 3.2.1.1 of Appendix B: Biodiversity Technical Report
<p>Item 5.5</p> <p>The BDAR must include details of the measures proposed to address offset obligations.</p>	Section 11.15

SEARs requirement	EIS section
<p>Item 5.6</p> <p>The Proponent must assess any impacts on biodiversity values not covered by the BAM. This includes a threatened aquatic species assessment (Part 7A <i>Fisheries Management Act 1994</i>) to address whether there are likely to be any significant impact on listed threatened species, populations or ecological communities listed under the <i>Fisheries Management Act 1994</i> (FM Act).</p>	Section 11.4.1, 11.4.4, 11.5.3.3, 11.10.2, 11.14 and Appendix S: Aquatic Biodiversity Technical Report
<p>Item 5.7</p> <p>The Proponent must identify whether the Project as a whole, or any component of the Project, would be classified as a key threatening process in accordance with the listings in the <i>BC Act 2016</i>, <i>FM Act 1994</i> and EPBC Act.</p>	Section 11.14
SEARs Attachment A— EPBC Act requirements	EIS section
<p>1. For each of the EPBC Act-listed species and ecological communities impacted by the proposed action, the EIS must provide:</p> <ul style="list-style-type: none"> a) Survey results, including details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Commonwealth guidelines and policy statements b) A description of the habitat and habits (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans, threat abatement plans and wildlife conservation plans, and <p>► Maps displaying the above information (specific to EPBC matters) overlaid with the proposed action.</p>	Section 11.4, 11.5 and Appendix B: Biodiversity Technical Report
<p>2. The EIS must describe the nature, geographic extent, magnitude, timing and duration of any likely direct, indirect and consequential impacts on any relevant EPBC Act-listed species and communities. It must clearly identify the location and quantify the extent of all impact areas to each relevant EPBC Act-listed species or community.</p>	Section 11.8
<p>3. For each of the EPBC-listed species and communities that are likely to be impacted by the development, the EIS must provide information on proposed avoidance and mitigation measures to deal with the impacts of the action. It must also provide a description of the predicted effectiveness and outcomes that the avoidance and mitigation measures will achieve.</p>	Section 11.9
<p>4. The EIS must identify each EPBC Act-listed species and community likely to be significantly impacted by the proposed action. Where a significant impact is likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit, how offsets will be secured, and timing of protection.</p>	Section 11.10 and 11.15
Item 6: Protected and Sensitive Lands	
Desired performance outcome	<p>The project is designed, constructed and operated to avoid or minimise impacts on protected and sensitive lands.</p> <p>The project is designed, constructed and operated to avoid or minimise future exposure to coastal hazards and processes.</p>
Current guidelines	<p><i>Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water</i> (DECCW, 2010)</p> <p><i>Revocation, Re-categorisation and Road Adjustment Policy</i> (OEH, 2012)</p> <p><i>Guidelines for controlled activities on waterfront land</i> (DPI, 2012)</p> <p><i>Policy and Guidelines for Fish Habitat Conservation and Management—Update 2013</i> (DPI, 2013)</p> <p><i>Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (DPI, 2003)</p>

SEARs requirement	EIS section
Item 6.1 The Proponent must assess the impacts of the Project on environmentally sensitive land and processes (and the impact of processes on the Project) including, but not limited to:	
a) Protected areas (including land and water) managed by the Office for Environment and Heritage (OEH) and/or Department of Primary Industries Fisheries (DPIF) under the <i>National Parks and Wildlife Act 1974</i> and the <i>Marine Estate Management Act 2014</i>	Section 11.5.8, 11.8 and Appendix B: Biodiversity Technical Report
b) Key fish habitat as mapped and defined in accordance with the FM Act 1994	Section 11.5.4 and 11.8
c) Waterfront land as defined in the <i>Water Management Act 2000</i>	Section 11.5.7 and 11.8
d) Land or waters identified as critical habitat under the BC Act, FM Act or EPBC Act	Section 11.5.6 and 11.8
e) Biobank sites, private conservation lands and other lands identified as offsets.	Section 11.5.8 and 11.15

11.3 Legislation, policies, standards and guidelines

This section describes the legislative, policy and management framework for the proposal, including:

- ▶ Legislative framework that applies to the assessment of ecological receptors applicable to the proposal at the Commonwealth and state levels and provides the statutory context for which the assessment has been undertaken
- ▶ Statutory approvals required as a result of potential impacts to terrestrial and aquatic ecology
- ▶ The approach to environmental offsets for significant residual impacts on BC Act listed receptors and MNES.

An overview of the Commonwealth and state legislation that is relevant to the proposal, outlining the intent of the legislation and applicability to the proposal is presented in Table 11.2.

TABLE 11.2 SUMMARY OF LEGISLATION, POLICIES, STRATEGIES OR GUIDELINES

Legislation, policy, strategy or guideline	Relevance to the proposal
Commonwealth	
<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i> (EPBC Act)	<p>The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places—defined in the Act as MNES. There are nine MNES to which the EPBC Act applies:</p> <ul style="list-style-type: none"> ▶ World heritage properties ▶ National heritage places ▶ Wetlands of international importance ▶ Listed threatened species and ecological communities ▶ Migratory species ▶ Commonwealth marine areas ▶ Great Barrier Reef Marine Park ▶ Nuclear actions ▶ A water resource, in relation to coal seam gas and large coal mining development. <p>The proposal has been referred to the Department of the Environment and Energy (DEE) and is considered a controlled action by the department because the department considers that the proposed action has the potential to significantly impact MNES and must therefore assess the significance of any potential impacts on MNES threatened species and communities. The EPBC Act controlling provisions for the proposed action are:</p> <ul style="list-style-type: none"> ▶ Listed threatened species and communities (section 18 and 18A).

*Environment Protection and
Biodiversity Conservation Act
1999 (Cth)* (EPBC Act)

All MNES protected under the triggered controlling provisions are potentially relevant. The department considers that the proposed action has the capacity to significantly impact the following:

- ▶ Brigalow (*Acacia harpophylla* dominant and co-dominant)—endangered
- ▶ Coolibah–Black box woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions—endangered
- ▶ Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland—critically endangered
- ▶ Weeping Myall woodlands—endangered
- ▶ White box–Yellow box–Blakely’s red gum grassy woodlands and derived native grassland—critically endangered
- ▶ Squatter pigeon (southern) (*Geophaps scripta scripta*)—vulnerable
- ▶ Painted honeyeater (*Grantiella picta*)—vulnerable
- ▶ Murray cod (*Maccullochella peelii*)—vulnerable
- ▶ Large-eared pied bat (*Chalinolobus dwyeri*)—vulnerable
- ▶ Corben’s long-eared bat (*Nyctophilus corbeni*)—vulnerable
- ▶ Koala (combined populations of Queensland, NSW and the ACT) (*Phascolarctos cinereus*)—vulnerable
- ▶ *Cadellia pentastylis* (Ooline)—vulnerable
- ▶ *Dichanthium setosum* (Bluegrass)—vulnerable
- ▶ *Homopholis belsonii* (Belson’s panic)—vulnerable
- ▶ *Tylophora linearis*—endangered
- ▶ Five-clawed worm-skink (*Anomalopus mackayi*)—vulnerable
- ▶ Adorned delma (*Delma torquata*)—vulnerable
- ▶ Dunmall’s snake (*Furina dunmalli*)—vulnerable.

Note that this may not be a complete list and it is the responsibility of the proponent to ensure any protected matters under this controlling provision are assessed for the Australian Government decision-maker’s consideration. Migratory species are not a controlling provision for the proposal.

The bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment (the Assessment Bilateral Agreement) is relevant to the proposal. The Assessment Bilateral Agreement allows the Australian Government Minister for the Environment to rely on specified environmental impact assessment processes of NSW in assessing action under the EPBC Act. While offset obligations can be calculated in Biodiversity Assessment Method (BAM) credits for EPBC Act projects, the Australian Government may not accept the specific application of the offset rules for projects approved before Amending Agreement No. 1 is signed. The Australian Government Minister or a delegate will determine this on a case by case basis.

It has been noted in the SEARs that: ‘A number of offsets options under the NSW BC Act will be acceptable for EPBC Act approval purposes. It is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action i.e. “like for like”. Like-for-like includes protection of native vegetation that is the same EEC or habitat being impacted, or funding to provide a direct benefit to the matter being impacted i.e. threat abatement, breeding and propagation programs or other relevant conservation measures.’

EPBC Act *Environmental Offsets Policy (2012)*

Where the proposal is determined to have a significant 'residual impact' on MNES offsets will need to be determined and approved by DEE.

Offsets are required under the EPBC Act to compensate for any residual impacts to MNES once avoidance and mitigation measures have been considered (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012). An offset must deliver an overall conservation outcome that improves or maintains the viability of the MNES and should be tailored specifically to the attribute of the MNES that is to be affected.

An offsets package is defined in the EPBC ACT *Offsets Policy* (DSEWPaC, 2012) as a suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a proposal. An offsets package can comprise of a combination of direct offset and other compensatory measures.

Direct offsets are actions that deliver a measurable conservation gain for an impacted protected matter. Conservation gains may be achieved by:

- ▶ Improving existing habitat for the protected matter
- ▶ Creating new habitat for the protected matter
- ▶ Reducing threats to the protected matter
- ▶ Increasing values of a heritage place, and/or averting the loss of a protected matter or its habitat that are under threat.

Where the proposal is determined to have a significant 'residual impact' on MNES offsets will need to be determined and approved by DEE.

State (NSW)

Environmental Planning and Assessment Act 1979 (EP&A Act)

The *Environmental Planning and Assessment Act* (EP&A Act) provides a statutory basis for planning and environmental assessment in NSW. The EP&A Act provides a framework for environmental planning and development approvals and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the proposal approval process.

The objective of this Act that are relevant to biodiversity are as follows:

- ▶ To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment
- ▶ To protect the environment, including the conservation of native animals and plants (including threatened species), ecological communities and their habitats.

The proposal is subject to assessment under Division 5.2 of the EP&A Act as it is state-significant infrastructure (SSI). This report forms part of the assessment under the Act.

Biodiversity Conservation Act 2016 (BC Act)

The BC Act came into effect on the 25 August 2017 and repealed the *Nature Conservation Trust Act 2001* (NSW), the *Threatened Species Conservation Act 1995* (NSW), the *Native Vegetation Act 2003* and components of the *National Parks and Wildlife Act 1974* (NSW).

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest wellbeing of the community, now and into the future, consistent with the principles of ecologically sustainable development (described in the *Protection of the Environment Administration Act 1991* (NSW) and Section 516A of the EPBC Act). Its purpose in particular is:

- ▶ To conserve biodiversity at bioregional and state scale
- ▶ To maintain the diversity and quality of ecosystems and enhance their capacity to adapt to change and provide for the needs of future generations
- ▶ To improve, share and use knowledge, including local and traditional Aboriginal ecological knowledge, about biodiversity conservation
- ▶ To support biodiversity conservation in the context of a changing climate
- ▶ To support collating and sharing data and monitoring and reporting on the status of biodiversity and the effectiveness of conservation actions

Legislation, policy, strategy or guideline	Relevance to the proposal
<i>Biodiversity Conservation Act 2016</i> (NSW) (BC Act)	<ul style="list-style-type: none"> ▶ To assess the extinction risk of species and ecological communities and identify key threatening processes, through an independent and rigorous scientific process ▶ To regulate human interactions with wildlife by applying a risk-based approach ▶ To support conservation and threat-abatement action to slow the rate of biodiversity loss and conserve threatened species and ecological communities in nature ▶ To support and guide prioritised and strategic investment in biodiversity conservation ▶ To encourage and enable landowners to enter into voluntary agreements over land for the conservation of biodiversity ▶ To establish a framework to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity ▶ To establish a scientific method for assessing the likely impacts on biodiversity values of proposed development and land use change, for calculating measures to offset those impacts and for assessing improvements in biodiversity values ▶ To establish market-based conservation mechanisms through which the biodiversity impacts of development and land use change can be offset at landscape and site scales ▶ To support public consultation and participation in biodiversity conservation and decision-making about biodiversity conservation ▶ To make expert advice and knowledge available to assist the minister in the administration of the Act. <p>From 25 August 2017, provisions in the <i>Threatened Species Conservation Act 1995</i> (NSW) dealing with assessment of impacts on threatened species, populations and ecological communities were repealed and replaced by provisions in the BC Act.</p> <p>The BC Act introduces a new biodiversity impact assessment and offset regime, including the Biodiversity Offsets Scheme, which must be applied to SSI projects.</p>
<i>Biodiversity Conservation Regulation 2017</i> (BC Regulation)	<p>Provides further regulation under the BC Act, particularly related to:</p> <ul style="list-style-type: none"> ▶ The protection of native animals and plants ▶ The declaration of areas of outstanding biodiversity value ▶ The listing criteria for threatened species and ecological communities ▶ Private land conservation agreements ▶ The biodiversity offsets scheme established by the Act and the Biodiversity Stewardship Payments Fund under the scheme ▶ Biodiversity assessments and approvals under the EP&A Act ▶ The biodiversity certification of land ▶ Public consultation ▶ The Biodiversity Conservation Trust ▶ Regulatory compliance mechanisms ▶ The retention, destruction or disposal of seized animals, plants or other things under the Act ▶ Criminal proceedings ▶ Other matters.
<i>Local Land Services Act 2013</i> (NSW)	<p>The <i>Local Land Services Act 2013 Act</i> (NSW) provides a governance framework and statutory corporation (Local Land Services) responsible for the delivery and management of local land services in the social, economic and environmental interests of the state. The <i>Local Land Services Act 2013</i> (NSW) defines Category 1—Exempt Land. Category 1 areas are exempt from assessment under the BAM and include areas used for perennial and seasonal horticulture and irrigated cropping.</p>

*Fisheries Management Act
1994 (FM Act)*

The FM Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. It applies in relation to all waters that are within the limits of the state and regulates certain activities that have the potential to impact on aquatic habitats and identifies key threatening processes.

The objects of the FM Act are:

- ▶ To conserve fish stocks and key fish habitats
- ▶ To conserve threatened species, populations and ecological communities of fish and marine vegetation
- ▶ To promote ecologically sustainable development, including the conservation of biological diversity.

Under the FM Act, development proponents are required to provide regulator notification of proposed works. Permits issued under the Act are required for:

- ▶ Works that would block the passage of fish in a bay, inlet, river or creek
- ▶ Dredging or reclamation works
- ▶ The construction of structures within aquatic habitats (e.g. bridges, roads, causeways, pipelines)
- ▶ Permits under this Act are not required because of the SSI provisions of the EP&A Act, but this Act is still relevant in terms of the aquatic biodiversity assessment.

The proposal is being assessed under Part 5 of the EP&A Act, with exemptions provided under section 5.23(1)(b) with regard to permits under the FM Act for the following actions relevant to the proposal:

- ▶ Blocking of fish passage by constructing or altering a dam, floodgate, causeway or weir, or otherwise create an obstruction
- ▶ Dredging work or reclamation work.

Other activities potentially relevant to the proposal that do require approval under the FM Act, i.e.:

- ▶ Channelisation, relocation or realignment of waterways, such as diversions
- ▶ Installation of pipelines across a waterway (involving dredging or reclamation)
- ▶ Installation of storm water outlets (involving reclamation of the bed or bank of a waterway).

Biosecurity Act 2015 (Cth)

Under the *Biosecurity Act 2015* (Cth), all native and non-native plants are regulated with a general biosecurity duty, *'to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.'* Declared weeds are known to occur within the proposal area and will be considered in weed-mitigation measures.

Biodiversity Assessment
Method (BAM)

The BAM is the assessment manual that outlines how an accredited person assesses impacts on biodiversity at development sites and the enhancement of biodiversity values at stewardship sites. It is a regulatory document that provides:

- ▶ A consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site
- ▶ Guidance on how a proponent can avoid and minimise potential biodiversity impacts
- ▶ The methods for determining the number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity.

An accredited assessor must apply the BAM. The assessor documents the results of the biodiversity assessment in a Biodiversity Development Assessment Report. The Biodiversity Development Assessment Report identifies how the proponent proposes to avoid and minimise impacts—any potential impact that could be characterised as serious and irreversible according to specified principles and the offset obligation required to offset the likely biodiversity impacts of the development or clearing proposal, expressed in biodiversity credits (refer Appendix B: Biodiversity Technical Report).

Vegetation assessments and biodiversity assessments contained in this report have been completed by an accredited assessor.

<i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i>	<p>These guidelines aim to maintain and enhance fish habitat for the benefit of native fish species, including threatened species, in marine, estuarine and freshwater environments. It is intended to assist developers, consultants, government and non-government organisations to comply with legislation, policies and guidelines related to fish habitat conservation and management. The guidelines provide:</p> <ul style="list-style-type: none"> ▶ Definitions of key fish habitat that legislative controls apply to ▶ Information on policy and legislation for planning and development assessment processes ▶ Tailored assessment processes for different development activities ▶ Guidance for proponents of developments or other activities affecting fish habitats.
<i>Why do fish need to cross the road? Fish passage requirements for waterway crossings (DPI, 2003)</i>	<p>These requirements have been developed to assist those involved in the planning, design, construction and maintenance of waterway crossings by providing practical guidelines to minimise impacts on fish passage and general aquatic wildlife.</p> <p>The guidelines include information on how crossings impact on fish passage, planning crossings, assessing crossing sites, design considerations, construction considerations, monitoring and maintenance considerations. The guideline has been used for the classification of fish habitat and field assessment of fish habitat.</p>

11.4 Methodology

11.4.1 Introduction

The assessment of biodiversity components for the proposal was undertaken using a multiple segment assessment process. Different assessment pathways were applied to receptors with different assessment requirements according to the relevant legislation. Receptors listed under the BC Act, EPBC Act and FM Act were assessed, as required for compliance with the SEARs. Areas which are not required to be assessed under the BAM include Category 1 land as identified within the *Local Land Services Act 2013* (NSW).

Methodologies used to assess and subsequently determine impact significance incorporated the techniques outlined in the BAM (as prescribed under the BC Act). For ecological receptors regulated under the EPBC ACT and FM Acts, assessments were undertaken in accordance with a Significant Impact Assessment Methodology (SIAM). An aquatic species impact assessment (the assessment of significance) was also completed for each FM Act ecological receptor to ensure compliance and consistency with the Act.

Receptors regulated under both the EPBC and BC Acts were assessed through each methodology. An ecological receptor is a feature, area or structure that may be affected by direct or indirect changes to the environment, including receptors identified by the SEARs, such as threatened species and ecological communities. Section 11.4.4 describes the BAM and SIAM methodologies in more detail. The BAM defines 'subject land' as the temporary construction footprint and is defined as the likely extent of the area needed to construct the proposal.

Under the BAM, the proponent must describe the area within the temporary construction footprint plus a 500 m buffer when describing a linear alignment such as the proposed rail line. For non-linear infrastructure or development, a 1,500 m buffer is required, such as for the proposed borrow pit areas for this proposal. For the purposes of this report, the temporary construction footprint plus the buffer areas required for the BAM assessment are hereon referred to as the study area (refer Figure 11.1).

A description of the proposal is available in Chapter 6: The Proposal, and Chapter 7: Construction of the Proposal.

11.4.2 Database and existing literature review

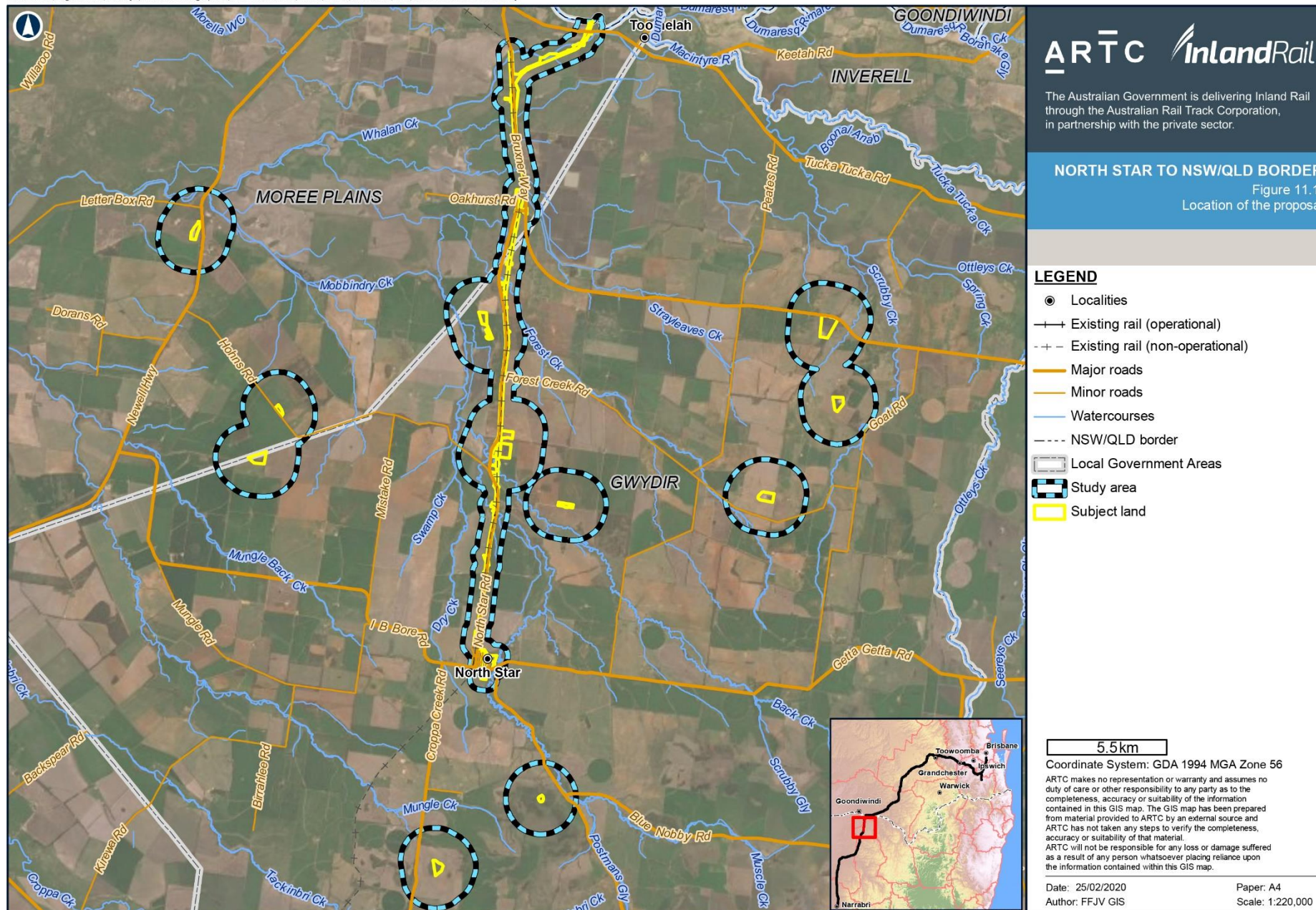
Existing information on the terrestrial and aquatic biodiversity of the subject land was obtained from a range of sources, including databases, aerial photographs and maps.

Previous documents and reports relevant to the subject land were reviewed, including regional and subregional vegetation mapping reports, site-specific monitoring surveys, ecological surveys and relevant ecological database searches.

Aerial photography (Future Freight Joint Venture (FFJV), 2019) for the subject land was reviewed to identify land-use patterns, extent of vegetation, relevant landscape/catchment matters and possible issues for the area.

As a matter of best practice, the desktop information listed below was reviewed. The review of literature included a desktop mapping (10 km buffer—referred to as the search area) and analysis exercise that examined available data for the subject land. Data sets, documents and other resources analysed included:

- ▶ NSW Environment, Energy and Science *BioNet Wildlife Atlas* threatened species records (accessed 7 August 2019)
- ▶ EPBC Act Protected Matters Search Tool (accessed 5 August 2019)
- ▶ Commonwealth, NSW and local legislation and planning instruments
- ▶ Ramsar and *Directory of Important Wetlands in Australia* wetlands and drainage mapping
- ▶ State Vegetation Type Map Secretary's Environmental Assessment Requirements (SEARs)
- ▶ Freshwater threatened species distribution maps
- ▶ FM Act Key Fish Habitat maps, 'Moree Plains' and 'Gwydir'
- ▶ Any relevant previous ecological assessments conducted for the site or adjacent areas.



Details of the existing literature and previous study reports which have been reviewed for the desktop component of the assessment are summarised in Table 11.3. These reports also consider other existing literature. The reports informed recent records of threatened species, which may not have been updated on government databases at the time of database searches.

TABLE 11.3 PROPOSAL-RELATED ASSESSMENTS AND REPORTS

Document title	Reference	Major findings
North Star to NSW/QLD Border Project Study Area Selection Report	ARTC, 2018	<ul style="list-style-type: none"> ▶ Alternative alignment options considered through multi-criteria analysis (MCA) ▶ Preferred study area identified in May 2017 workshop ▶ Study area up to 2 km wide to allow for future alignment changes following Phase 2 Feasibility Assessment.
Melbourne to Brisbane Inland Rail, 2016 Phase 1 Continuity Alignment Report, North Star to Yelarbon	WSP Parsons Brinckerhoff, 2017a	<ul style="list-style-type: none"> ▶ MCA comparison of east and west possible alignments ▶ Confirmation of North Star to Border investigation area (west) ▶ Investigation area includes two possible alignments to cross the Macintyre River.
Melbourne to Brisbane Inland Rail, 2016 Phase 2 Preparatory Alignment Assessment Report, North Star to Yelarbon	WSP Parsons Brinckerhoff, 2017b	<ul style="list-style-type: none"> ▶ 6-km wide study area within the west option created to investigate possible Macintyre River crossing locations ▶ River crossing study area reduced to 2 km to allow further refinement.
Narrabri to North Star Project, Environmental Impact Statement. <i>Technical Report 2: Biodiversity Assessment Report</i>	ARTC 2017	<p>A Biodiversity Assessment Report identified the following offset requirements for the N2NS project:</p> <ul style="list-style-type: none"> ▶ 18,826 ecosystem credits required for eight threatened ecological communities (TECs) ▶ 364 species credits for finger panic grass (<i>Digitaria porrecta</i>) ▶ 2,607 species credits for creeping tick-trefoil (<i>Desmodium campylocaulon</i>) ▶ 1,898 species credits for Belson's panic (<i>Homopholis belsonii</i>) ▶ 632 species credits for koala (<i>Phascolarctos cinereus</i>).

11.4.3 Field surveys

11.4.3.1 Terrestrial ecology

A representative sampling approach was employed as part of the field sampling methodology in accordance with the BAM guidelines. Seasonal surveys, i.e. spring (mid-September to mid-December) and autumn (late February to April) have occurred from 1 October–9 October 2018; 31 October–6 November 2018; 18 June–24 June 2019; 1 July–7 July 2019; and 23 October–30 October 2019.

Field surveys were undertaken by BAM-accredited ecologists in accordance with the BAM and relevant state and Commonwealth threatened species guidelines, including the *Threatened Biodiversity and Assessment Guidelines for Developments and Activities—Working Draft* (DEC, 2004) and *Commonwealth Threatened Species Survey and Assessment Guidelines* (various, DoEE, 2010).

Terrestrial flora field surveys included the following methodologies:

- ▶ Surveys to confirm and map plant community types (PCTs) and TECs to confirm accuracy with the *NSW Vegetation Information System* was undertaken using a rapid vegetation assessment (Rapid Data Points). At each rapid site, the dominant canopy, mid-storey and groundcover species, structural cover condition, vegetation structure, PCT, priority or environmental weed species and cover, opportunistic threatened species counts, soil texture, fire history, vegetation condition, landform element and pattern, notes, photo number, surveyor, and date was recorded.
- ▶ Vegetation integrity assessment (site condition) plots were undertaken in accordance with the BAM-based desktop assessments to enable the recognition of PCTs. Within each plot, information relating to composition, structure and function was recorded, in addition to meandering transects to search for threatened flora species.
- ▶ TEC assessments were conducted within vegetation zones within the subject land to compare key diagnostic criteria and condition thresholds to determine the presence of the EPBC Act-listed TECs. The natural grasslands' TEC potentially present in the study area (natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland) was assessed as per the EPBC Act thresholds; however, extended drought conditions were present at the time of the site assessments, impacting the condition of these areas substantially and making detailed assessments not feasible. As such, the grassland TEC has been assumed as present for the purposes of this report until such time as a detailed site assessment is possible.

In order to assess fauna, a preliminary assessment using the BAM Calculator (see Section 11.5.3.1) and broad PCT mapping was undertaken by a BAM-accredited assessor. This process provided a list of species-credit fauna species that may require survey in accordance with the BAM requirements. In accordance with the BAM, species identified as ecosystem-credit species are predicted by landscape attributes and are not required to undergo targeted surveys because of their cryptic nature. Some species may be both ecosystem-credit (foraging) and species-credit (breeding sites) species.

Under the BAM, where the likelihood of occurrence of a threatened species or elements of the threatened species' habitat can be predicted by vegetation surrogates and landscape features, or for which the targeted survey has a low probability of detection, are identified in the threatened biodiversity data collection as 'ecosystem credit species'. Targeted surveys are not required for these species. Threatened species where the likelihood of occurrence of a species or elements of suitable habitat for the species cannot be confidently predicted by vegetation surrogates and landscape features and can be reliably detected by survey are identified in the threatened biodiversity data collection as 'species credit species'. To date, detailed habitat assessments have not occurred within the borrow pit locations. These surveys form part of the future planned ecological investigations for the proposal.

The *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities—Working Draft* (DEC, 2004) and *Commonwealth Threatened Species Survey and Assessment Guidelines* (DEE, 2010) were considered when undertaking the threatened species surveys in the subject land.

The baseline sampling of vertebrate fauna species was undertaken using the following methods:

- ▶ Fauna habitat assessments—each site
- ▶ Active searches—60 minutes each site
- ▶ Microchiropteran bat call detection—38 nights across targeted sites
- ▶ Camera traps—91 nights across targeted sights
- ▶ Visual and auditory identification surveys of birds—60 minutes each site
- ▶ Spotlighting—60 minutes over three nights each site
- ▶ Call playback—three repeats at each targeted site
- ▶ Incidental observations.

Targeted fauna surveys for suitable species credit species occurred between 23 October and 30 October 2019. This survey included searches for species with no specified survey months and species that had October as one of the specified survey months. It also included a detailed assessment of fauna habitat, including the size and height of tree hollows at each location in order to determine if suitable breeding habitat was present for other species credit species.

Further information on the surveys, including the locations of survey sites and survey effort, is provided in Appendix B: Biodiversity Technical Report.

11.4.3.2 Aquatic ecology

Prior to field investigations for the alignment, a desktop assessment was undertaken to identify existing aquatic features within 10 km of the subject land. Analysis included a review of existing field data as well as existing datasets that were publicly available (refer Appendix S: Aquatic Biodiversity Technical Report for further details). This included but was not limited to:

- ▶ Freshwater threatened species distribution maps
- ▶ FM Act Key Fish Habitat maps: Moree Plains and Gwydir
- ▶ Ramsar and Directory of Important Wetlands in Australia wetlands and drainage mapping.

Following a review of government databases and existing ecological field data/investigations, as detailed above, an aquatic ecology field assessment was conducted in August 2018. A single survey period was considered to be sufficient. The use of historical surveys and datasets accounted for seasonal detectability, in addition to the use of predictive habitat models in the ecology impact assessment. The predictive habitat models were verified in the field using data collected during the proposal field survey. Habitat assessment and field data was collected to inform a likelihood of occurrence assessment for threatened aquatic species within the study area. Small waterbodies exist at many of the proposed borrow pit sites; however, these are considered to be artificial impoundments resulting from extractive industries and were not subject to further assessment. These areas are not consistent with the definition of waterbodies as prescribed under the FM Act. Instead, they fit the definition as intermittent lagoons or wetlands filled from localised runoff and are not otherwise hydrologically connected to other permanent habitats such as rivers, creeks, estuaries and ocean.

The aquatic ecology field assessment described the environmental values of targeted drainage systems within the subject land. The *Australian River Assessment System (AUSRIVAS) Physical Assessment Protocol* (Parsons et.al., 2002) was used in the field assessment of aquatic habitat. The assessment informed the threatened aquatic species assessment (Part 7A FM Act 1994) required as per the SEARs. The AUSRIVAS Physical Assessment Protocol is a standardised rapid method for the collection of geomorphological, physical habitat and riparian data. It was used to maintain consistency with the sampling approach that has been employed on other Inland Rail projects. This provided a repeatable and standard approach that allows for cumulative impacts associated with the proposal to be assessed.

The key geomorphological, physical habitat and riparian data that was collected at each assessment site included:

- ▶ Valley characteristics, including valley shape and channel slope
- ▶ Land use, including catchment land use and local land use
- ▶ Physical morphology and bedform of the watercourse, including channel shape and extent and type of bars
- ▶ Cross-sectional dimensions of the watercourse, including bankfull channel width and depth, bank width and height and baseflow stream width and depth
- ▶ Substrate characteristics, including bed compaction, sediment angularity, bed stability rating, sediment matrix and substrate composition
- ▶ Floodplain characteristics, including floodplain width and features
- ▶ Bank characteristics, including bank shape and slope, bank material, bedrock outcrops, factors affecting bank stability and artificial bank protection measures
- ▶ Instream vegetation and organic matter, including extent of large woody debris, macrophyte cover and species composition
- ▶ Physical condition indicators and habitat assessment
- ▶ Riparian vegetation characteristics, including shading of channel, extent of trailing bank vegetation, species compositions, riparian zone width and extent of disturbance
- ▶ Water quality visual observations, including turbidity, water and sediment oils, water and sediment odours, algae and moss cover. Qualitative water quality observations were supported by collection of water samples for quantitative assessments as part of the proposal surface water quality investigations (refer Chapter 13: Surface Water and Hydrology).

The habitat value and fish habitat type of each aquatic ecology assessment site was assessed to describe the aquatic fauna assemblages that were considered likely to use the area. Aquatic habitat assessments were conducted with respect to the policy and guidelines for *Fish Habitat Conservation and Management* (Department of Primary Industries (DPI), 2013), which outlines the features important for fish habitat in freshwater, estuarine and marine areas.

Waterways within the study area were assessed with regards to their classification for fish passage, with applicable waterways allocated a classification between Class 1 and 4 in accordance with DPI (2003) (refer Appendix S: Aquatic Biodiversity Technical Report).

Recordings of incidental fauna species observed during the aquatic field survey were taken at each aquatic ecology assessment site. A sample of aquatic fauna species present at the time of the aquatic sampling was undertaken using baited traps and dip netting, specifically targeting vertebrate species, such as fish and turtles, as appropriate. Habitat assessment and field data was collected to inform a likelihood of occurrence assessment for threatened aquatic species within the ecology study area. Macroinvertebrate sweeps, fish trapping and electrofishing were specifically excluded from the field methodology due to the largely ephemeral nature of the watercourses along the length of the subject land, except for the Macintyre River (perennial). This approach was adopted to maintain consistent survey methods and effort across sites.

During the aquatic ecology field investigations, data was collected with respect to any aquatic invasive species and other disturbances present within or affecting the aquatic environments.

Further information on the surveys, including the locations of survey sites, is provided in Appendix S: Aquatic Biodiversity Technical Report.

11.4.4 Impact assessment methodology

The assessment of biodiversity components for the proposal was undertaken using a multiple segment assessment process that was driven by compliance with the SEARs. Methodologies used to assess and subsequently determine impact significance used those outlined in the BAM (as prescribed under the BC Act) and for ecological values regulated under the EPBC Act, undertaken in accordance with the SIAM. Table 11.4 summarises the ecological receptors relevant to each assessment methodology. An ecological receptor is a feature, area or structure that may be affected by direct or indirect changes to the environment. The sections below describe the BAM and SIAM in more detail.

For ecological receptors that were not regulated under the BC Act (e.g. MNES as listed only under the provision of the EPBC Act) assessments were undertaken in accordance with SIAM, which considered ecological receptor sensitivity and the magnitude of potential related impacts on the specific ecological receptor. For ecological receptors regulated under the FM Act, assessment was undertaken partly in accordance with the SIAM, specifically through predictive habitat modelling in order to identify aquatic ecological receptors likely to be impacted by the proposal. The significance of impacts to FM Act regulated aquatic ecological receptors following predictive habitat modelling was determined as per the FM Act determinations of whether proposed development or activity likely to significantly affect threatened species, population or ecological community (FM Act significant impact assessment).

TABLE 11.4 ASSESSMENT METHODOLOGIES WITH CORRESPONDING LEGISLATION AND RELEVANT ECOLOGICAL RECEPTORS

Assessment methodology	Legislation associated with ecological receptor	Ecological receptor
BAM	BC Act	Threatened flora and fauna
		Habitat for threatened species
		BC Act listed TECs
		Native vegetation
SIAM using magnitude and sensitivity	EPBC Act	Threatened flora and fauna (non-BC Act)
		EPBC Act listed TECs
		Other MNES
SIAM and FM Act significant impact assessment	FM Act	Threatened aquatic species
		Threatened populations
		Endangered ecological communities (EEC)

11.4.4.1 Biodiversity assessment method

The BAM sets out the requirements for a repeatable and transparent assessment of Biodiversity Technical Report values on land in order to:

- ▶ Identify areas of non-native vegetation which do not require further assessment (Category 1 land)
- ▶ Identify the biodiversity values on land subject to proposal, clearing, or land in a biodiversity certification assessment area, or land proposed as a biodiversity stewardship site
- ▶ Determine the impacts of the proposal, or clearing on biodiversity certification on biodiversity values
- ▶ Quantify and describe the biodiversity credits required to offset the residual impacts of the proposal or clearing or conferral of biodiversity certification on biodiversity values
- ▶ Quantify and describe the biodiversity credits that can be created at a biodiversity stewardship site from the improvement in biodiversity values from management actions undertaken at the site.

Where required under NSW legislation, the BAM is used to assess Biodiversity Technical Report values on a proposal site or proposed clearing site or land proposed for biodiversity certification. It must also be used to assess the biodiversity values on land proposed to be secured under a biodiversity stewardship agreement. The terms of the proposal, proposal footprint and proposal site are also taken to include clearing, clearing footprint and clearing site, respectively, except where the reference is to a small area development or a major project development. The BAM defines the 'subject land' as the temporary construction footprint and is defined as the likely extent of the area needed to construct the proposal. For the purposes of this assessment, and following the precautionary principle, impacts to the maximum disturbance area within the subject land, including proposed borrow pits, temporary and permanent disturbance, were assessed. The subject land is divided into segments to allow for required credits to be calculated for each segment separately. The alignment and each borrow pit are separated into segments.

The assessment requirements set out in the BAM enable the survey and assessment effort to be scaled depending on the level of risk posed by the impact of the proposal, the availability and quality of existing information, such as native vegetation maps, and the area of land that is being assessed.

Impacts of the proposal, clearing or certification on biodiversity values, or gains in biodiversity values at biodiversity stewardship sites are measured in biodiversity credits. There are two broad categories of classes of credit for the purposes of measuring impact or gain—ecosystem credits and species credits. The BAM will step through the credit class category that is created or required for certain kinds of impact or gain. Each credit is assigned attributes to determine whether a particular credit within a class is 'like' another credit in the same class for the purpose of applying the like-for-like rules and variation rules set out in the *Biodiversity Conservation Regulation 2017*. A class of credits is formed where the biodiversity credit shares the same attributes. Ecosystem credits have seven shared attributes. For species credits, the only shared attribute is the name of the threatened species. Attributes are considered when determining suitable like-for-like offset credits.

The BAM incorporates three distinct stages (refer Figure 11.2). Stage 1 involves desktop and fieldwork-based assessment of biodiversity values within and adjacent to the subject land. Stage 2 involves the assessment of proposed impacts on biodiversity values identified in Stage 1. Impact assessment follows the mitigation hierarchy of avoid, minimise then mitigate. Stage 3 occurs during the detailed design phase, following submission of the EIS, and aims to improve biodiversity values.

Under the BAM, the proponent must describe the area within the disturbance footprint plus a 500 m buffer when describing a linear alignment such as the proposed rail line. For non-linear infrastructure or development, a 1,500 m buffer is required, such as for the proposed borrow pit areas for this proposal. For the purposes of this report, the disturbance footprint plus the required buffer areas required for the BAM assessment are hereon referred to as the study area. It is envisaged that not all borrow pits will be used and that those which are will be commissioned at different stages of the Project. As such, each borrow pit has been assessed as a separate 'project' to ensure the correct number of BAM plots and targeted surveys have occurred. This has allowed for both cumulative impacts to be assessed over the whole North Star to Border section of the alignment as well as targeted assessment of the localised impacts associated with each borrow pit.

As the borrow pits have been assessed individually, they have a 1,500 m buffer, where Borrow pit 7 intersects with the alignment the assessment has included a 500 m buffer for the alignment and a 1,500 m buffer for the borrow pit. The assessment for the alignment was conducted separately to that of Borrow pit 7 and, as such, has separate BAM plots associated with it. This will make any offsets associated only with Borrow pit 7 or the alignment easier to separate should Borrow pit 7 not be used for the Project.

Further information on the BAM and Biodiversity Development Assessment Report is provided in Appendix B: Biodiversity Technical Report.

Overview of the Biodiversity Assessment Methodology (BAM)

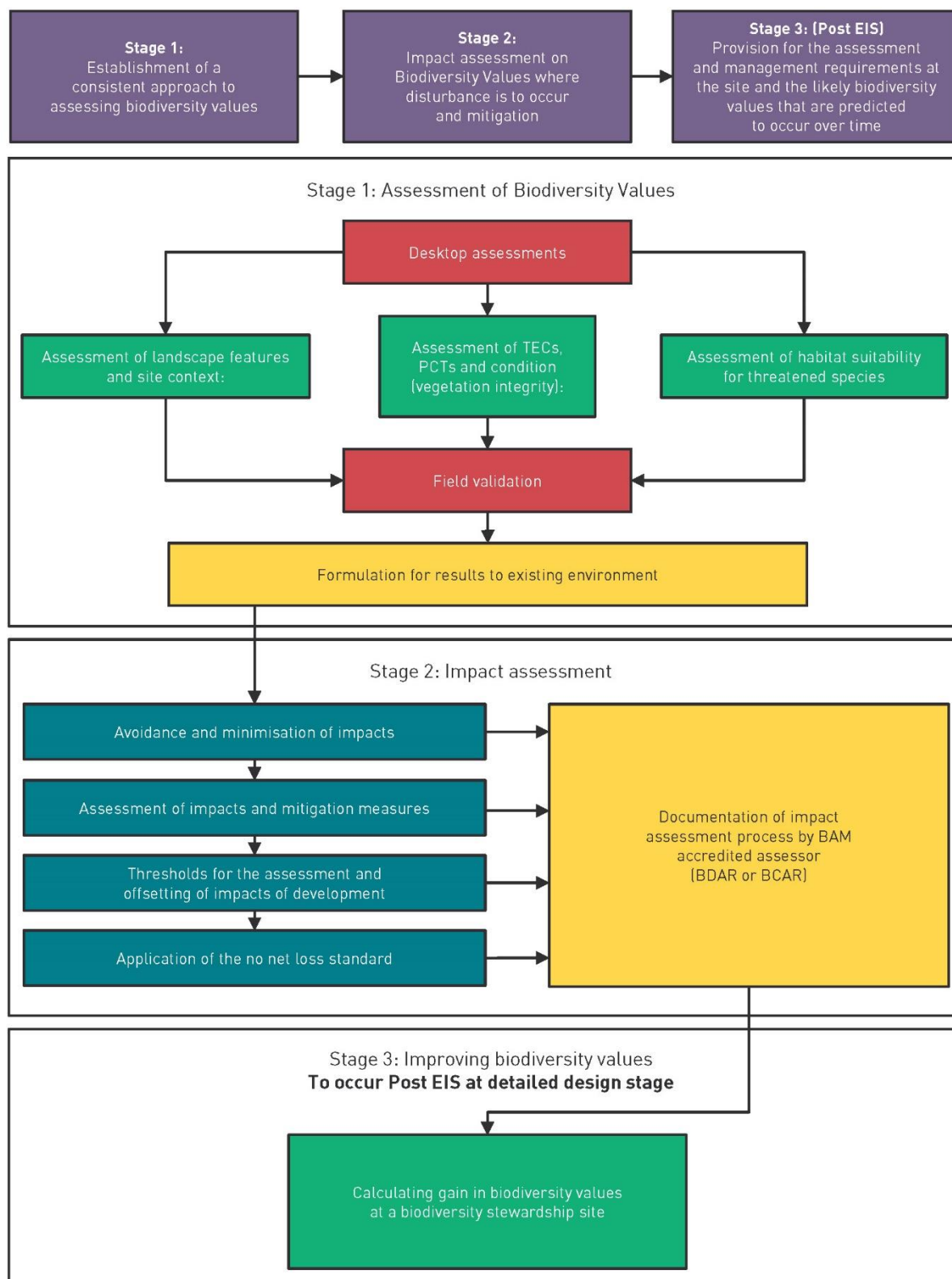


FIGURE 11.2 BIODIVERSITY ASSESSMENT METHOD APPROACH

11.4.4.2 Significant impact assessment methodology for matters of national environmental significance: predictive habitat modelling and the adverse impact assessment methodology

For ecological receptors not covered by the BAM, the SIAM was used to determine the impact of the proposal on ecological receptors. The SIAM uses a significance-based impact assessment framework to identify and assess proposal-related impacts regarding ecological receptors. Several stages were involved in the assessment of proposal impacts to ecological receptors, which included identifying potential impacts resulting from the proposal, the sensitivity of the ecological receptors to impacts, and the magnitude of impacts (i.e. quantum).

For the purpose of impact assessment, terrestrial and aquatic ecology receptors were assessed both quantitatively and qualitatively (refer Appendix B: Biodiversity Technical Report and Appendix S: Aquatic Biodiversity Technical Report). The significance of an impact is a product of the sensitivity of an ecological value and the magnitude of the potential impact to the specific ecological receptor. Magnitude is determined by the intensity, duration and spatial extent of impacts. Determining the sensitivity or vulnerability of the ecological receptor and the magnitude of the potential proposal-related impacts helps in the assessment of the significance of potential ecological impacts.

The use of predictive habitat models facilitated the quantification of potential impact magnitudes and subsequent impact significance, and highlighted where proposal mitigation measures, where required. Tests of significance were then re-assessed after mitigation measures were applied, to identify residual adverse impacts. In instances where MNES were subject to a significant residual adverse impact, the Adverse Impact Assessment Methodology (AIAM) was applied to identify the spatial extent and location of the significant adverse residual in accordance with the EPBC Act guidelines. Full methodologies associated with the AIAM is presented in Appendix B: Biodiversity Technical Report.

Aquatic ecological receptors regulated under the FM Act were assessed via the predictive habitat modelling component of the SIAM. For these aquatic ecological receptors, the final determination of significant adverse residual impacts was made through the FM Act significant impact assessment instead of the AIAM.

11.5 Description of environmental values

11.5.1 Landscape features and vegetation communities

Landscape features have been identified within a 500 m buffer from the boundary of the proposal along the alignment and 1,500 m surrounding the borrow pits (the study area) as defined by the BAM. The subject land traverses different Interim Biogeographic Regionalisation for Australia (IBRA) bioregions and subregions, Mitchell landscape areas, various stream orders and connective features. Landscape features applicable to the subject land are described in Table 11.5.

TABLE 11.5 LANDSCAPE FEATURES

Landscape feature	Brigalow Belt South IBRA Northern Basalts	Brigalow Belt South IBRA Northern Outwash	Darling Riverine Plains IBRA Castlereagh–Barwon
Alignment			
Subject land	117.34 ha	66.59 ha	143.28 ha
Native vegetation extent (500 m buffer)	426 ha	135 ha	497 ha
Percent native vegetation cover (500 m buffer)	33%	20%	47%
Mitchell landscapes	<ul style="list-style-type: none"> ▶ Croppa Clay Plains ▶ Macintyre Alluvial Plains 	<ul style="list-style-type: none"> ▶ Croppa Creek Channels and Floodplains ▶ Croppa Clay Plains ▶ Macintyre Alluvial Plains 	<ul style="list-style-type: none"> ▶ Barwon Channels and Floodplains ▶ Macintyre Alluvial Plains ▶ Croppa Clay Plains ▶ Macintyre Alluvial Plains
IBRA Bioregion	Brigalow Belt South	Brigalow Belt South	Darling Riverine Plains
IBRA Subregion	Northern Basalts	Northern Outwash	Castlereagh–Barwon

Landscape feature	Brigalow Belt South IBRA Northern Basalts	Brigalow Belt South IBRA Northern Outwash	Darling Riverine Plains IBRA Castlereagh–Barwon
Rivers, streams, estuaries (Strahler order)	▶ Forest Creek (3rd order stream)	▶ Mobbindry Creek (3rd order stream) ▶ Back Creek (3rd order stream)	▶ Whalan Creek (2nd order stream) ▶ MacIntyre River (6th order stream)
Wetlands	None	None	▶ Water reservoir associated with a cotton crop ▶ Floodplain wetland associated with MacIntyre River
Connecting features	▶ Forest Creek	▶ Mobbindry Creek ▶ Back Creek	▶ Whalan Creek ▶ MacIntyre River
Areas of geological significance and soil hazard features	Great Artesian Basin	Great Artesian Basin	Great Artesian Basin
Areas of outstanding biodiversity value	None	None	None
Combined borrow pits			
Subject land	125.67 ha	69.37 ha	None
Native vegetation extent (1,500 m buffer)	620.60 ha	1320.43 ha	None
Percent native vegetation cover (500 m buffer)	34%	19%	31%
Mitchell landscapes	▶ Croppa Clay Plains ▶ Macintyre Alluvial Plains ▶ Yallaroi Basalts	▶ Croppa Clay Plains ▶ Macintyre Alluvial Plains	▶ Macintyre Alluvial Plains ▶ Barwon Channels and Floodplains ▶ Croppa Clay Plains ▶ Macintyre Alluvial Plains
IBRA Bioregion	Brigalow Belt South	Brigalow Belt South	Darling Riverine Plains
IBRA Subregion	Northern Basalts	Northern Outwash	Castlereagh–Barwon
Rivers, streams, estuaries (Strahler order)	▶ Forest Creek (3rd order stream)	▶ Back Creek (3rd order stream) (Borrow pit 7)	▶ Macintyre River (6th order stream) ▶ Whalan Creek (2nd order stream)
Wetlands	None	None	▶ Water reservoir associated with a cotton crop ▶ Floodplain wetland associated with MacIntyre River
Connecting features	Forest Creek	▶ Mobbindry Creek ▶ Back Creek	▶ Whalan Creek ▶ Macintyre River
Areas of geological significance and soil hazard features	Great Artesian Basin	Great Artesian Basin	Great Artesian Basin
Areas of outstanding biodiversity value	None	None	–

Surveys of the subject land identified 14 PCTs across three broad condition states, equating to 27 distinct vegetation types which are listed in Table 11.6 (refer Figure 11.3). These PCTs were aligned with communities described as part of the Vegetation Information System Classification Database (Office of Environment and Heritage (OEH), 2016a). The PCTs were then categorised into 31 vegetation zones within the alignment and 23 vegetation zones within the borrow pits, based on condition and location within the IBRA subregions.

TABLE 11.6 PLANT COMMUNITY TYPES AND BROAD CONDITION CLASSES

PCT ID	Plant community types	Condition classes
PCT 27	Weeping Myall open woodlands of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Medium
PCT 35	Brigalow–Belah open forest/woodlands on alluvial, often gilgaied, clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion	High Low
PCT 36	River red gum tall to very tall open forest/woodlands wetland on rivers on floodplains, mainly in the Darling Riverine Plains Bioregion	High Medium Low
PCT 52	Queensland bluegrass +/- Mitchell grass grassland on cracking clay floodplains and alluvial plains mainly in the north-eastern Darling Riverine Plains Bioregion	Medium
PCT 53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Medium
PCT 55	Belah woodlands on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	High
PCT 56	Poplar Box–Belah woodlands on clay–loam soils on alluvial plains of north-central NSW	High Medium Low
PCT 98	Poplar box–white cypress pine–wilga–ironwood shrubby woodlands on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	High
PCT 147	Mock olive–wilga–peach bush–carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion	High Medium
PCT 192	Silver-leaved ironbark–poplar box +/- ironwood shrub–grass woodlands on rises in the north-western plains of NSW	Medium Low
PCT 244	Poplar box grassy woodlands on alluvial clay–loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	High Medium Low
PCT 247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Medium Low
PCT 418	White cypress pine–silver-leaved ironbark– wilga shrub grass woodlands of the Narrabri–Yetman region, Brigalow Belt South Bioregion	High Medium Low
PCT 628	Carbeen +/- Coolabah grassy woodlands on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion	Medium Low

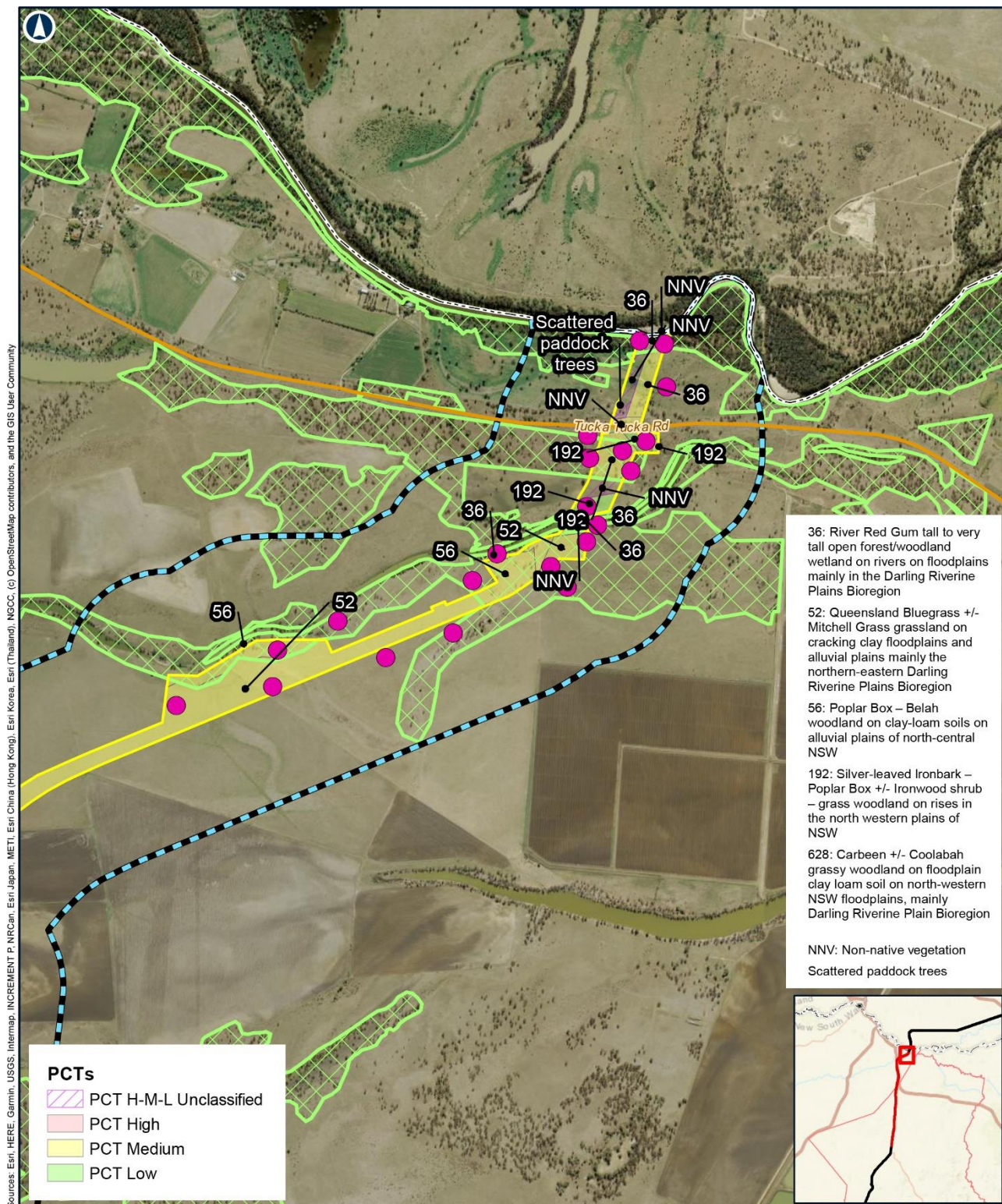


FIGURE 11.3A-P FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

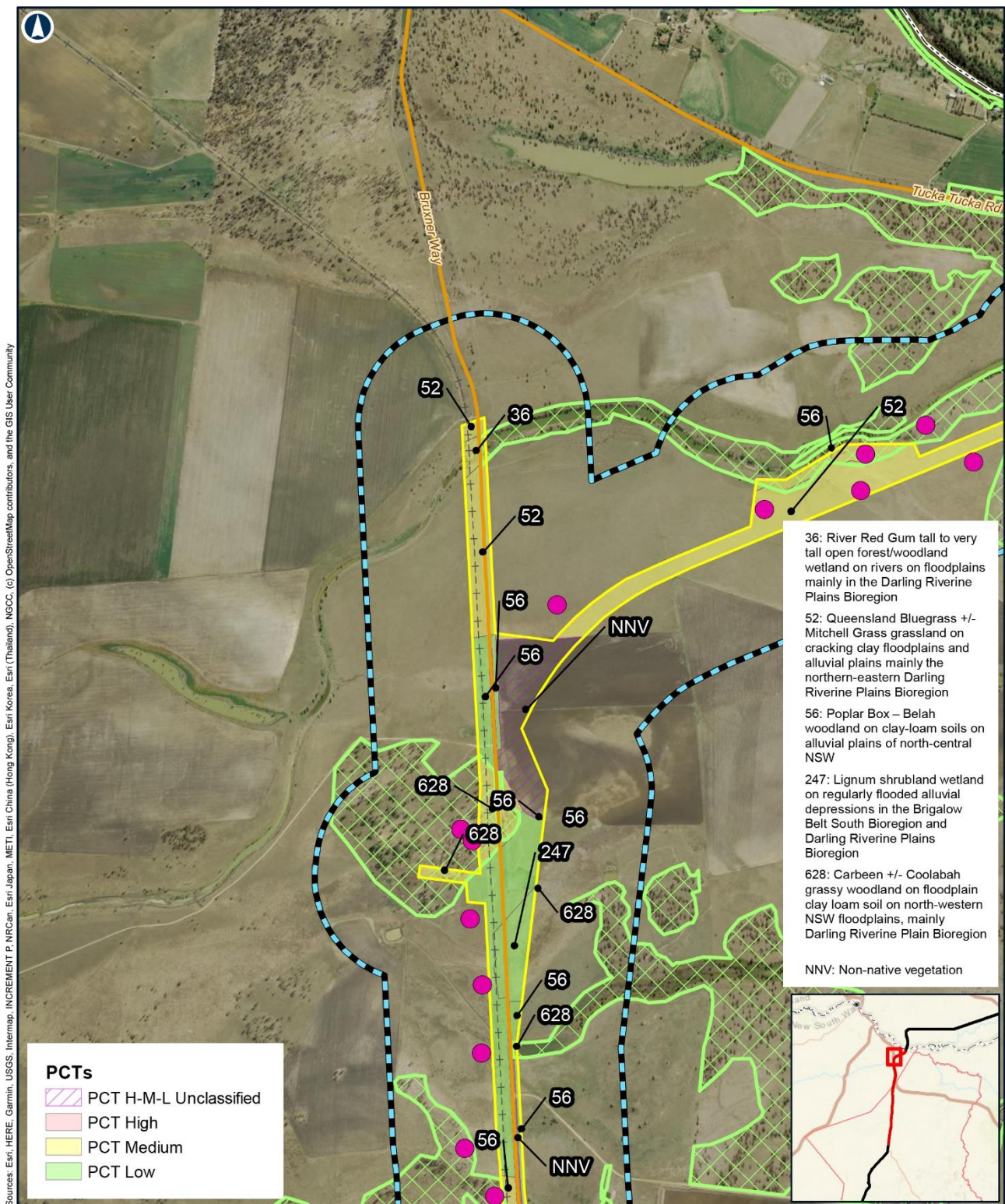


FIGURE 11.3B FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

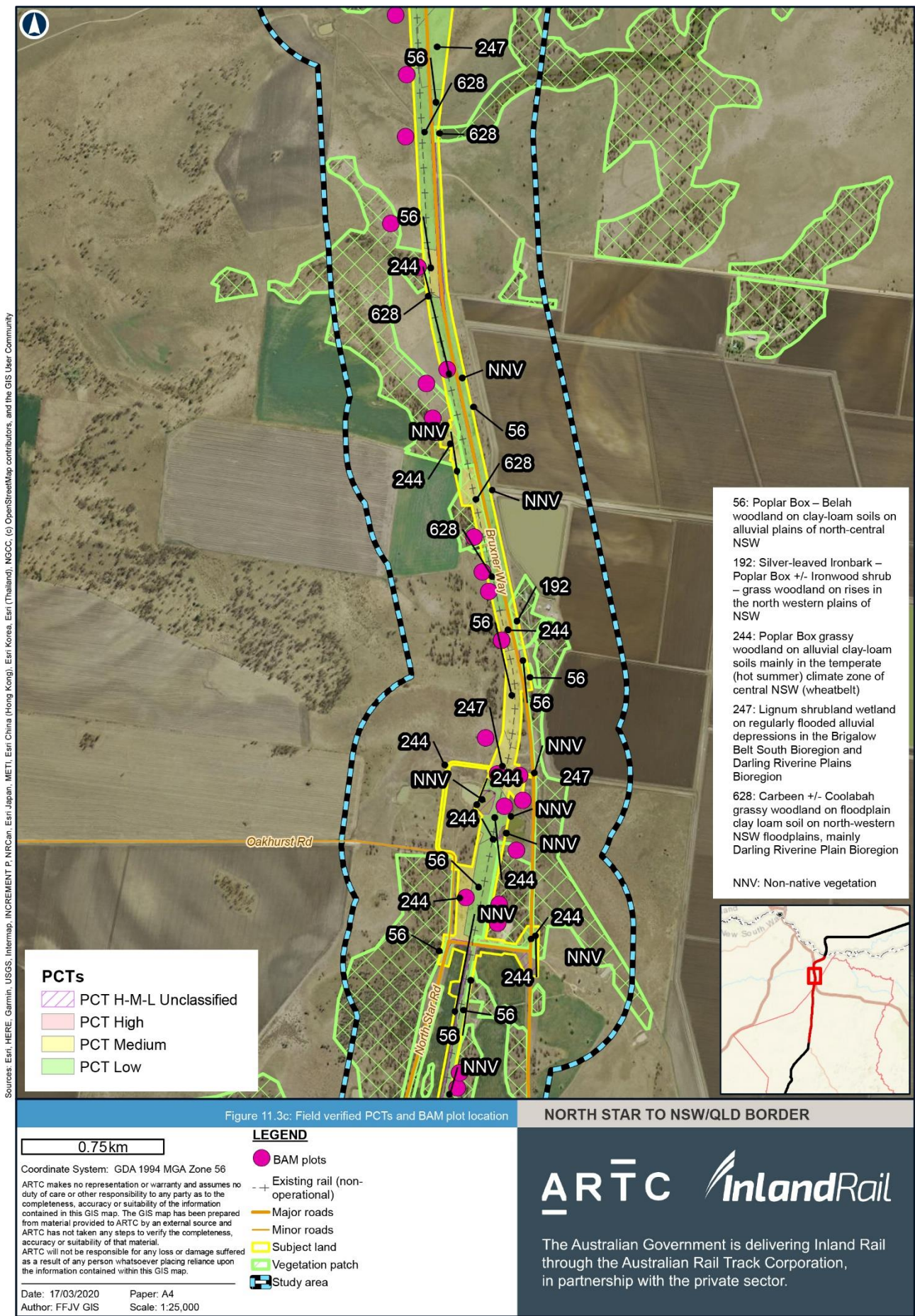


FIGURE 11.3C FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

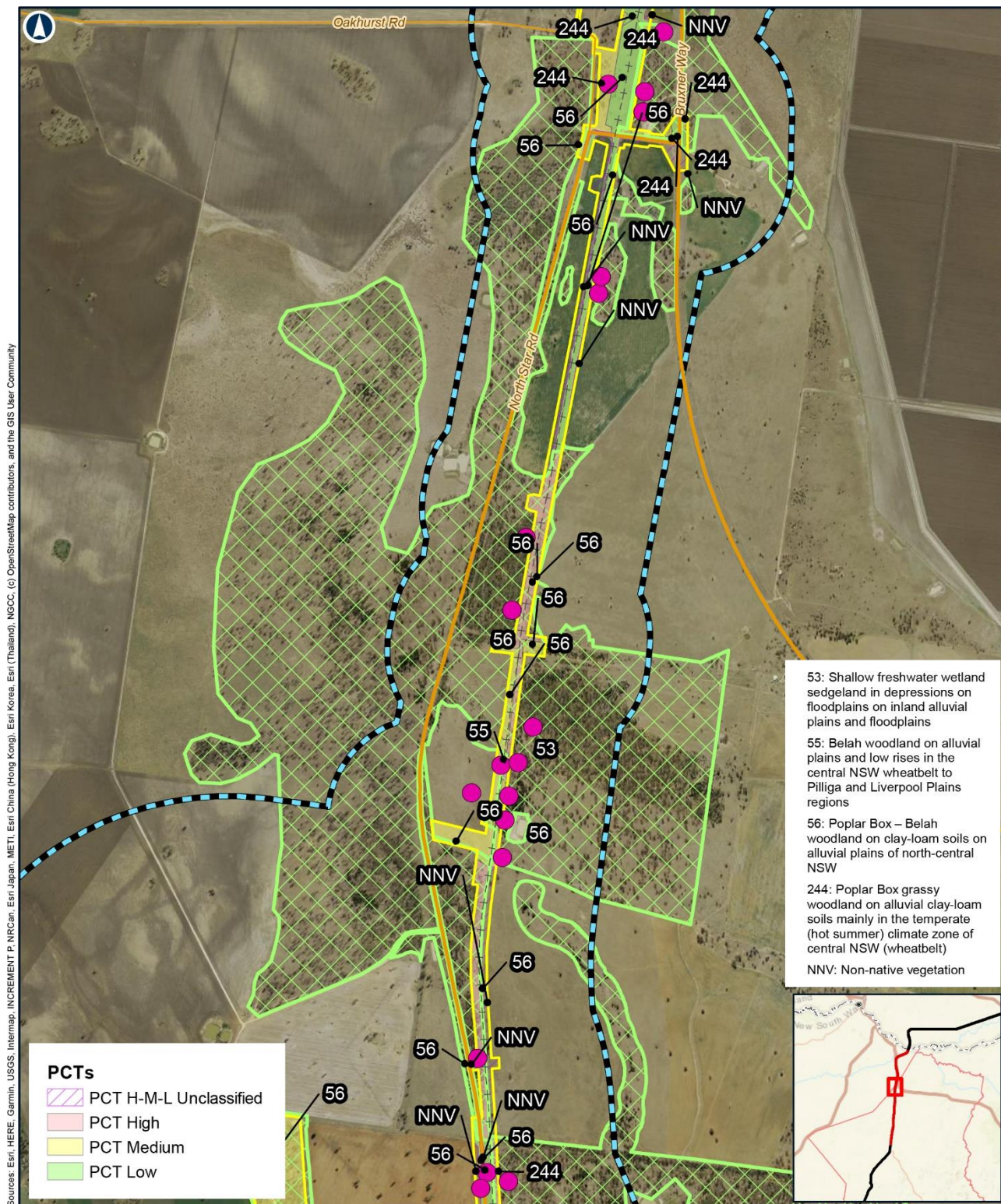


FIGURE 11.3D FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

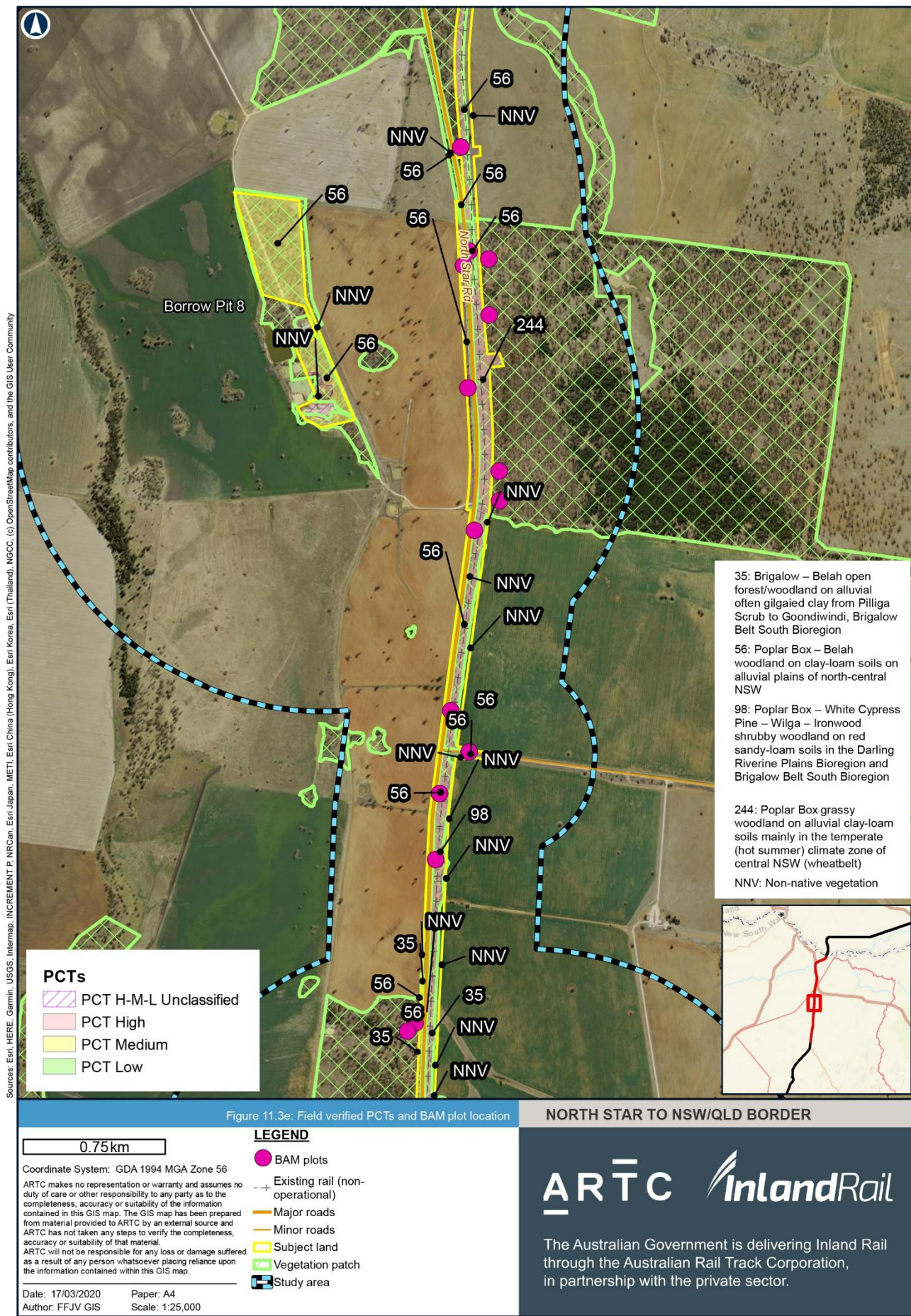


FIGURE 11.3E FIELD VERIFIED PCTS AND BAM PLOT LOCATIONS

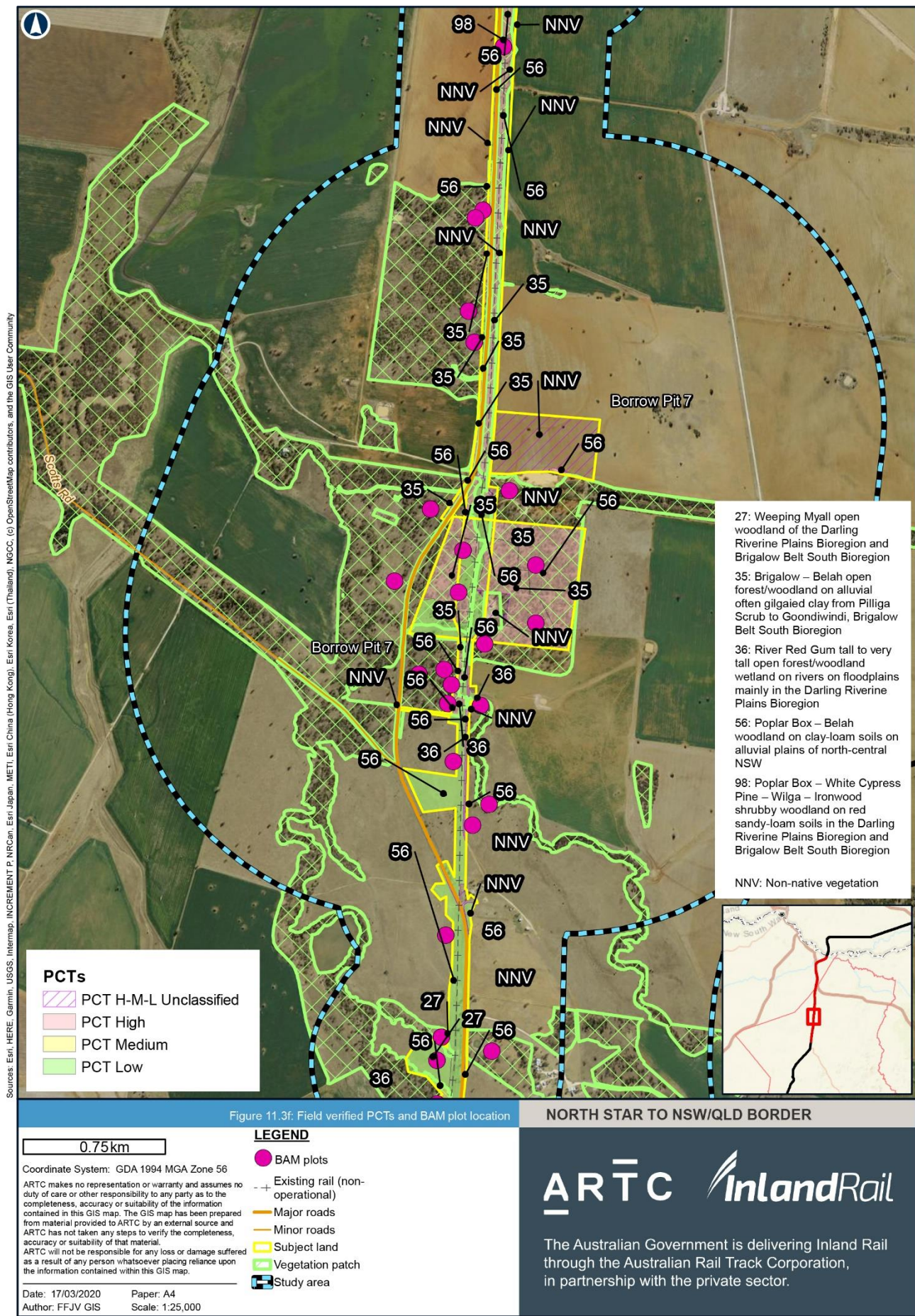


FIGURE 11.3F FIELD VERIFIED PCTS AND BAM PLOT LOCATIONS

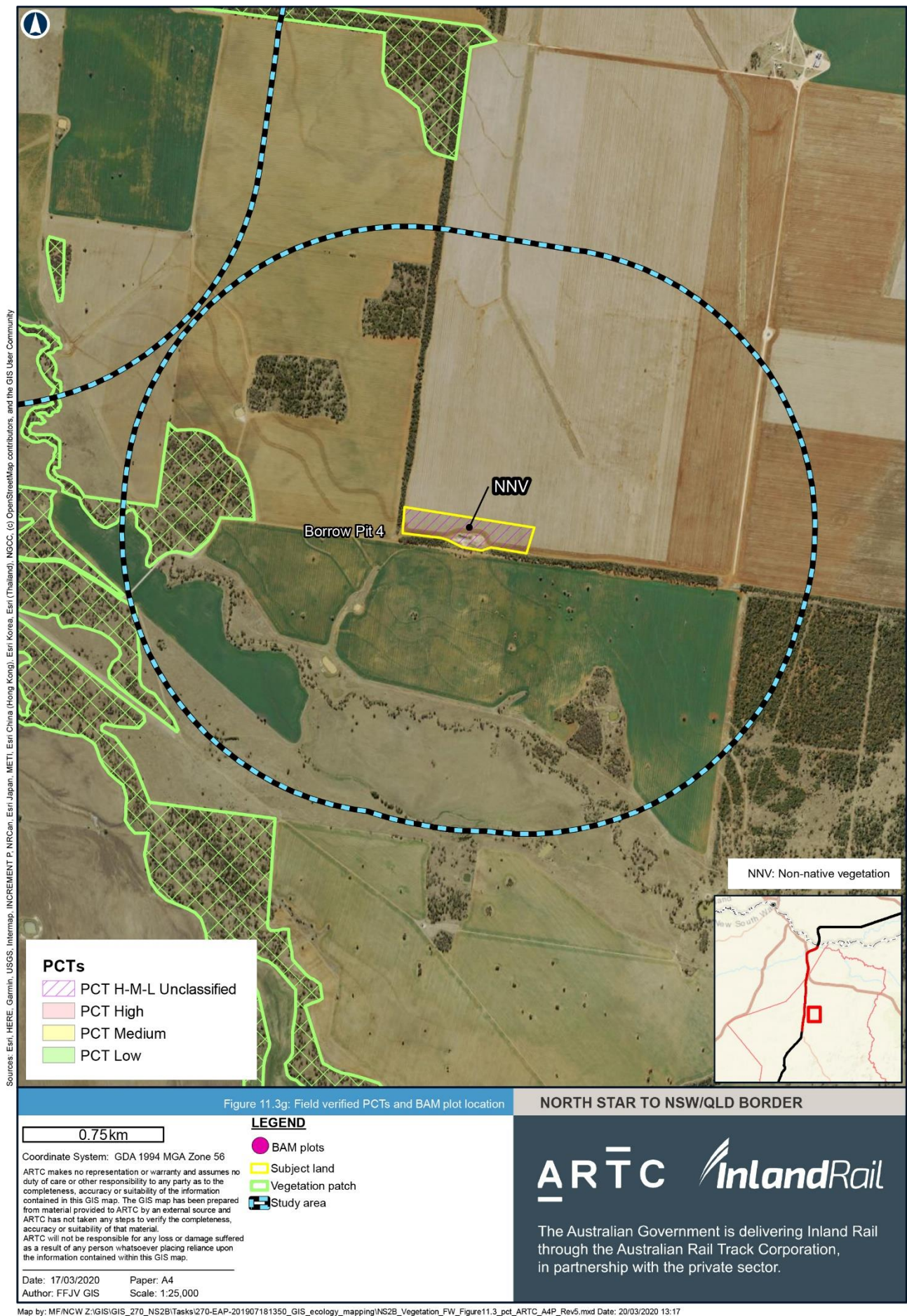


FIGURE 11.3G FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

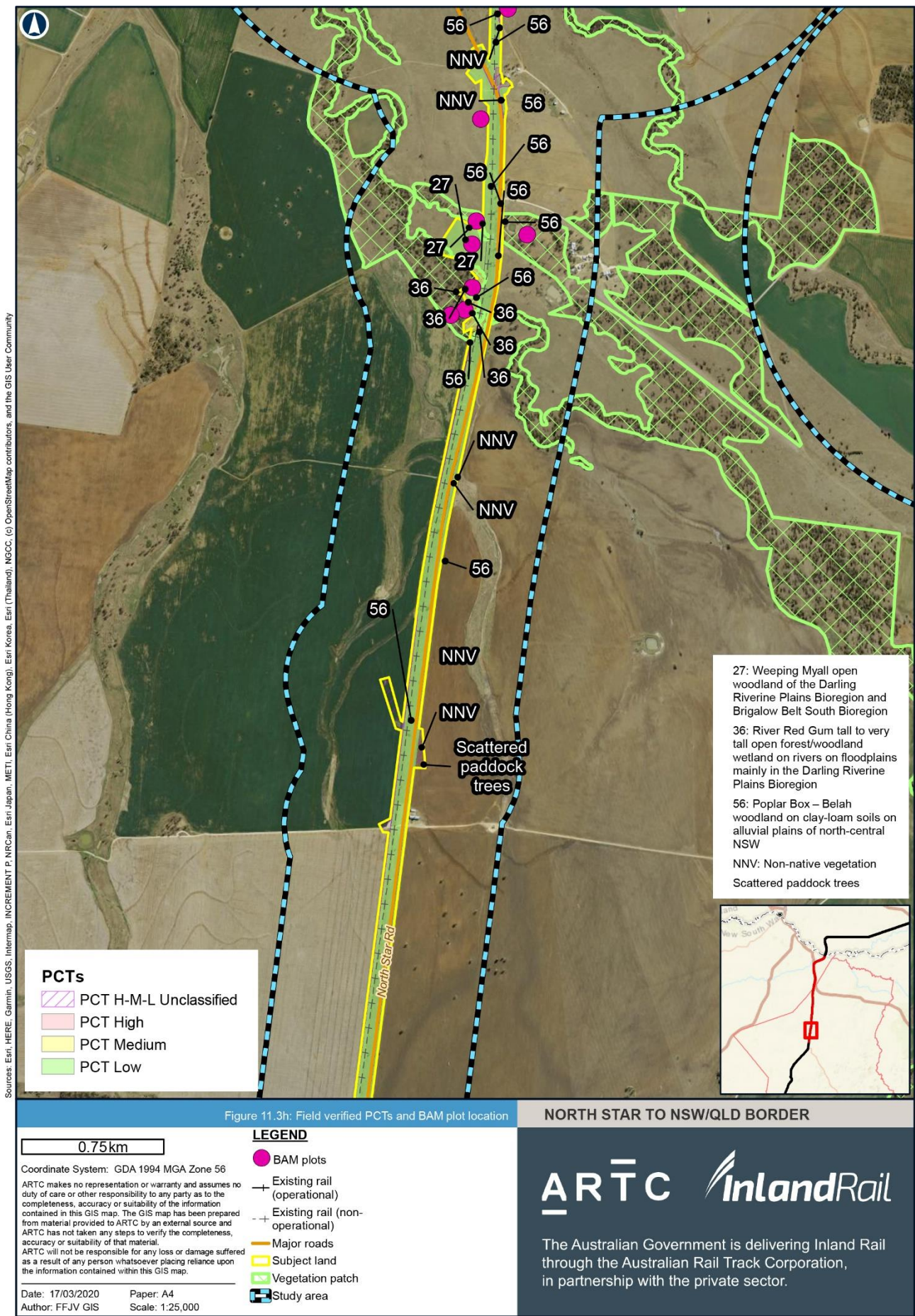


FIGURE 11.3H FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

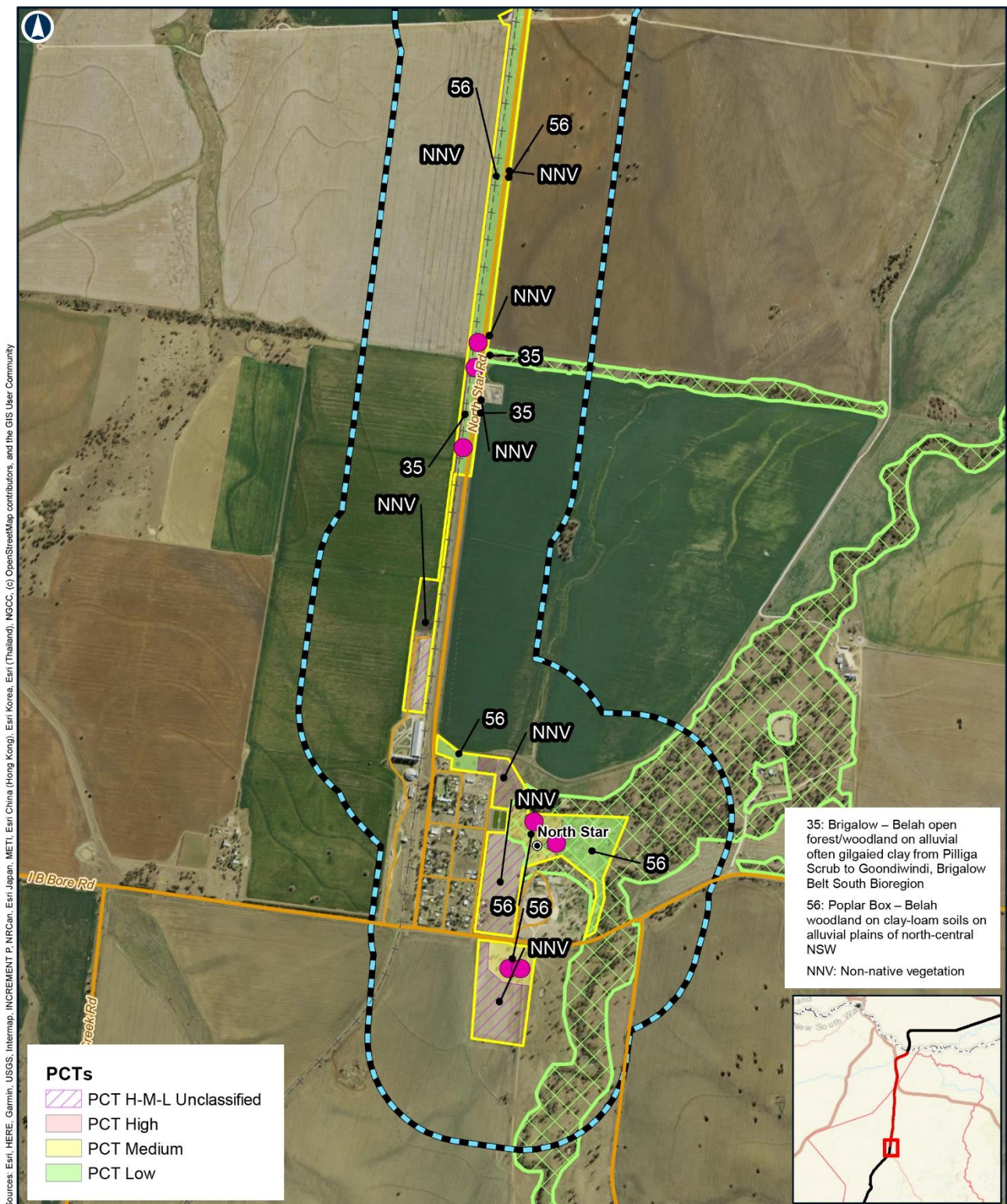


Figure 11.3i: Field verified PCTs and BAM plot location

NORTH STAR TO NSW/QLD BORDER

ARTC **InlandRail**

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation, in partnership with the private sector.

FIGURE 11.3I FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

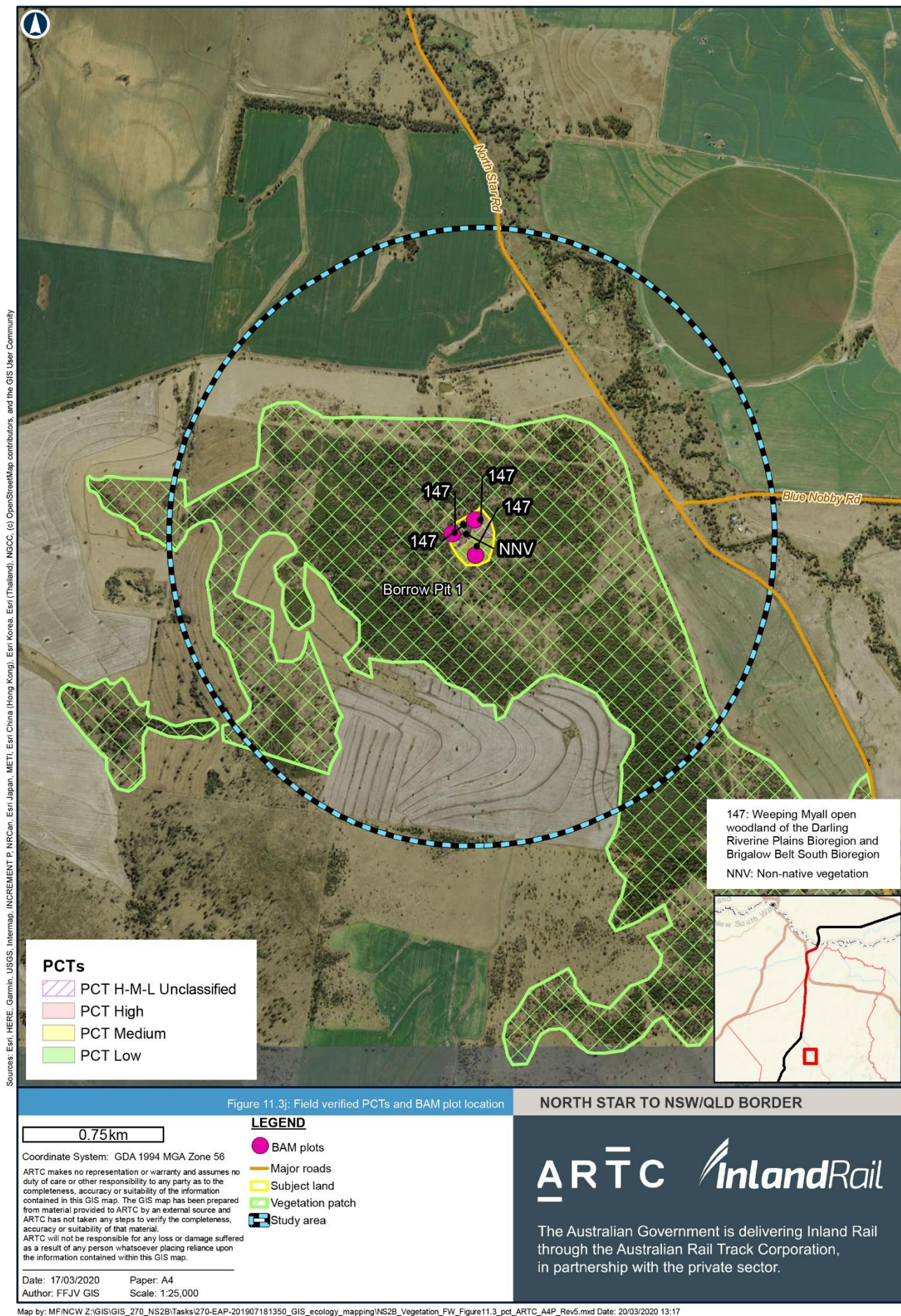


FIGURE 11.3J FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

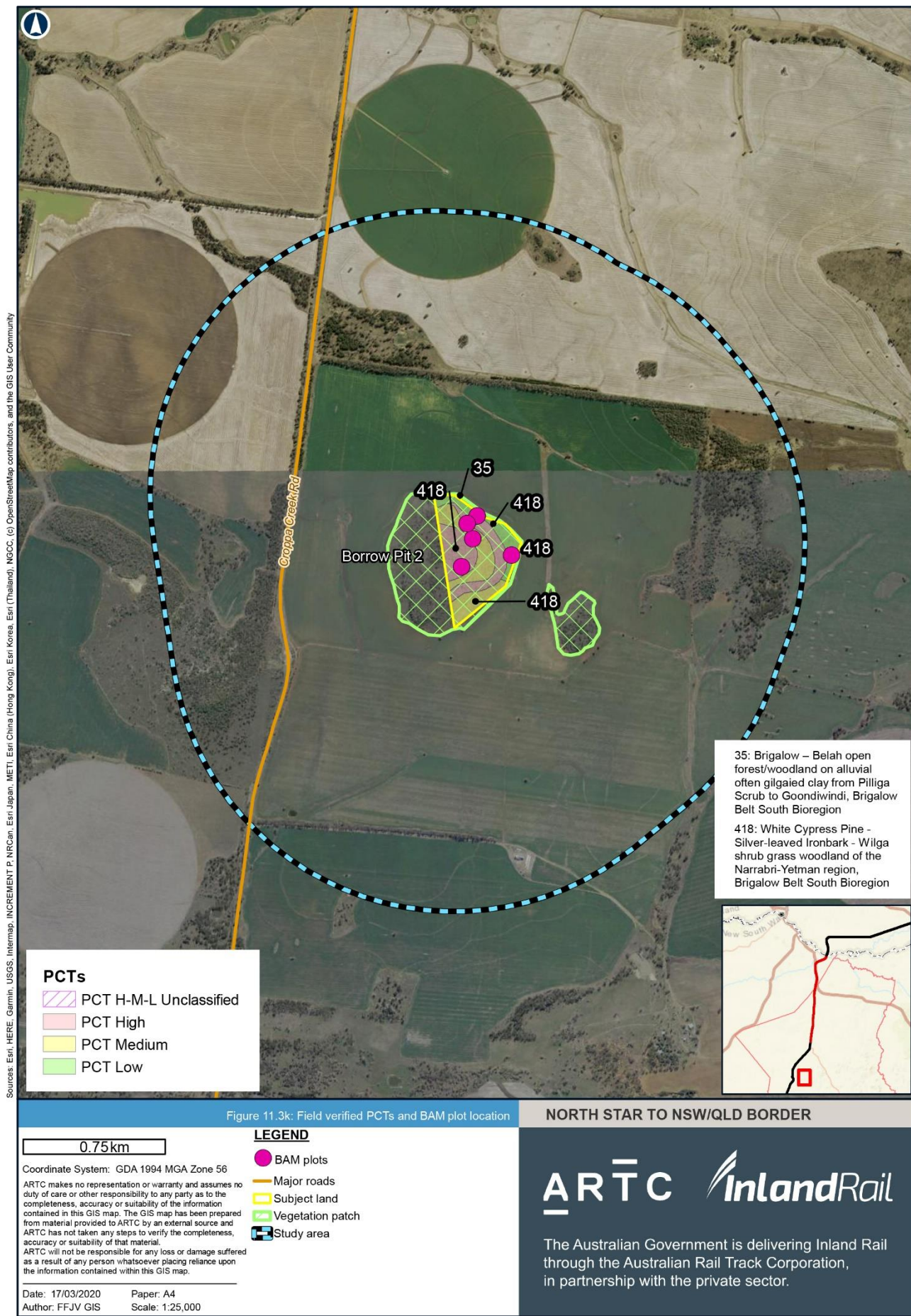


FIGURE 11.3K FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

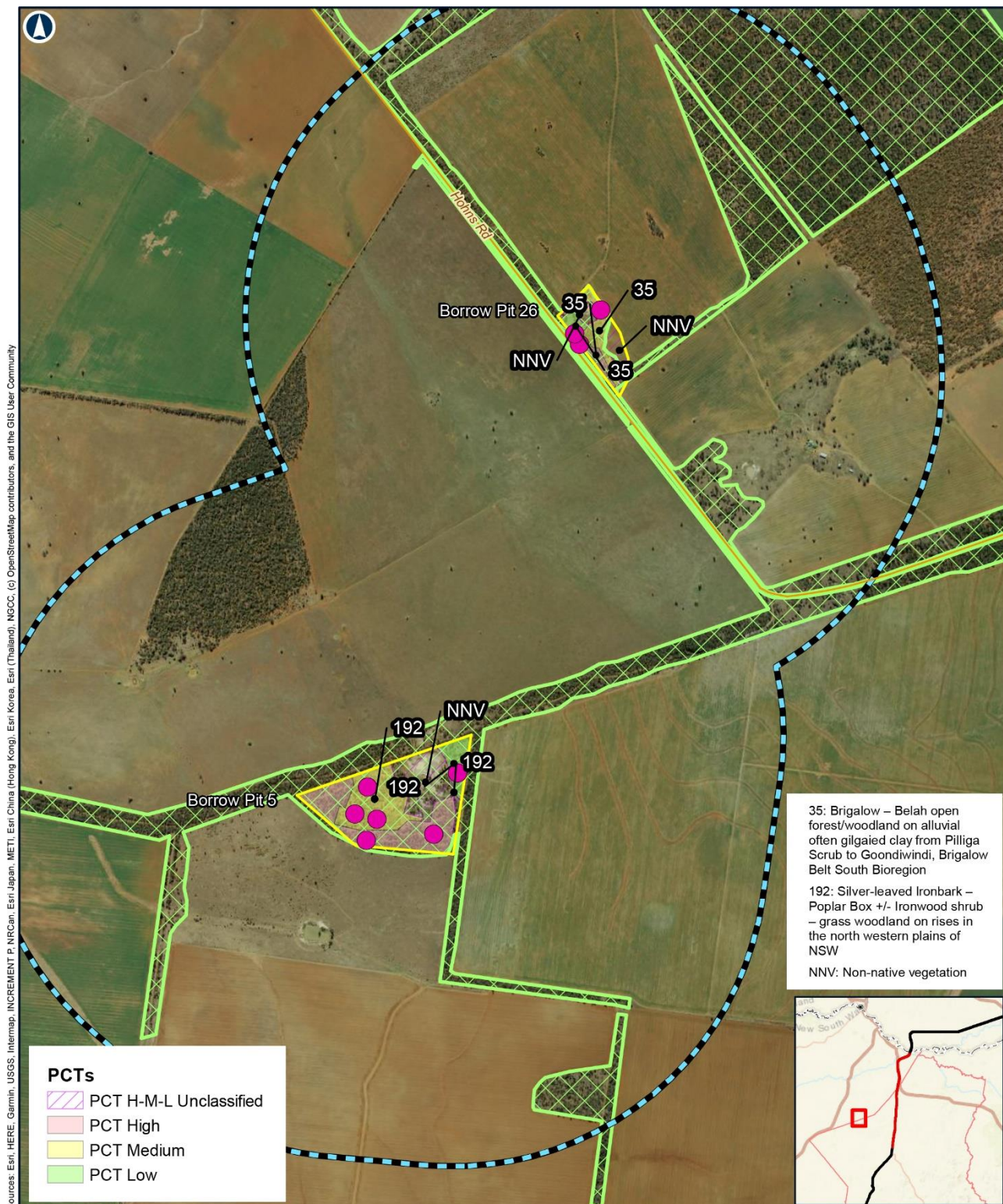


Figure 11.3m: Field verified PCTs and BAM plot location

NORTH STAR TO NSW/QLD BORDER

0.75km

Coordinate System: GDA 1994 MGA Zone 56

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Date: 17/03/2020

Paper: A4

Author: FFJV GIS

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Map by: MF\NCW Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-201907181350_GIS_ecology_mapping\NS2B_Vegetation_FW_Figure11.3_pct_ARTC_A4P_Rev5.mxd Date: 20/03/2020 13:17

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FIGURE 11.3M FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

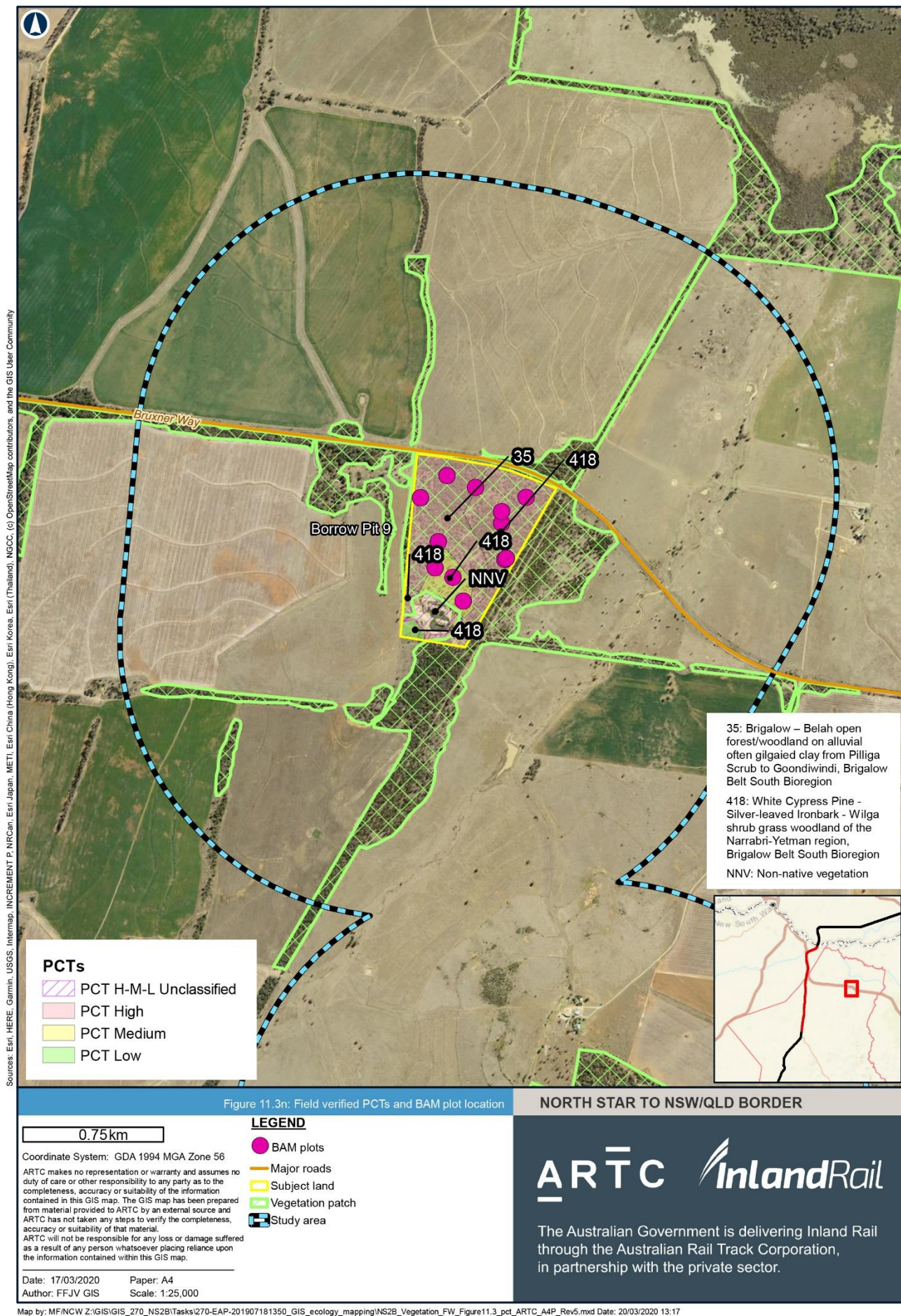


FIGURE 11.3N FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS

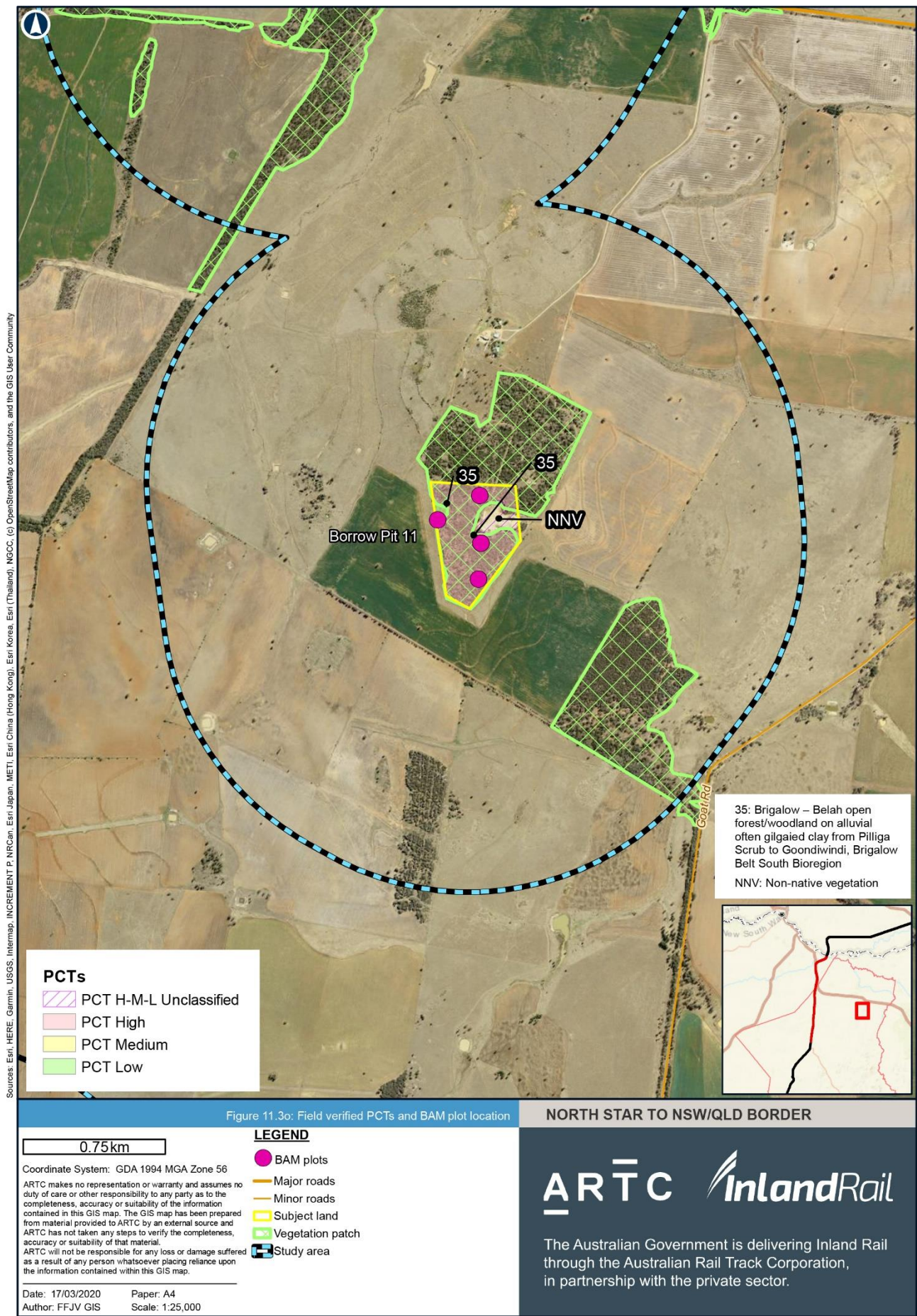


FIGURE 11.30 FIELD VERIFIED PCTs AND BAM PLOT LOCATIONS



FIGURE 11.3P FIELD VERIFIED PCTS AND BAM PLOT LOCATIONS

TABLE 11.7 PLANT COMMUNITY TYPES CONSISTENT WITH NSW THREATENED ECOLOGICAL COMMUNITIES AND ANALOGOUS TO EPBC ACT THREATENED ECOLOGICAL COMMUNITIES

Plant community type	BC Act threatened ecological communities	Analogous TEC under the EPBC Act	Presence BC Act threatened ecological communities	Presence of EPBC Act TEC
PCT 27 Weeping Myall open woodlands of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.	Myall woodlands in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray–Darling Depression, Riverina and NSW South Western Slopes bioregions	Weeping Myall woodlands	Present	Present
PCT 35 Brigalow–Belah open forest/woodlands on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	Present	Present
PCT 36 River Red Gum tall to very tall open forest/woodlands wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	N/A	N/A	N/A	N/A
PCT 52 Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the north-eastern Darling Riverine Plains Bioregion	N/A	Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	NA	Present
PCT 55 Belah woodlands on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	Coolibah–Black Box woodlands in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregion	Coolibah–Black Box woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Absent	Absent
	Myall woodlands in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray–Darling Depression, Riverina and NSW South Western Slopes bioregions	Weeping Myall woodlands	Absent	Absent
	Semi-evergreen vine thicket in the Brigalow Belt South and Nandewar Bioregions	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Absent	Absent
PCT 56 Poplar Box–Belah woodlands on clay–loam soils on alluvial plains of north-central NSW	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	Absent	Absent

Plant community type	BC Act threatened ecological communities	Analogous TEC under the EPBC Act	Presence BC Act threatened ecological communities	Presence of EPBC Act TEC
PCT 56 Poplar Box–Belah woodlands on clay–loam soils on alluvial plains of north-central NSW	Carbeen open forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions	N/A	Absent	N/A
	N/A	Poplar Box grassy woodlands on Alluvial Plains	N/A	Present
PCT 98 Poplar Box–White Cypress Pine–Wilga–Ironwood shrubby woodlands on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion <i>High</i>	N/A	N/A	N/A	N/A
PCT 192 Silver-leaved Ironbark–Poplar Box +/- Ironwood shrub–grass woodlands on rises in the north western plains of NSW <i>Medium–low</i>	N/A	N/A	N/A	N/A
PCT 147 Mock Olive–Wilga–Peach Bush–Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion	Semi-evergreen vine thickets of the Brigalow Belt South and Nandewar Bioregions	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Present	Present
PCT 244 Poplar Box grassy woodlands on alluvial clay–loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	Absent	Absent
	N/A	Poplar Box Grassy woodlands on Alluvial Plains	N/A	Present
PCT 247 Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	N/A	N/A	N/A	N/A
PCT 418 White Cypress Pine–Silver-leaved Ironbark–Wilga shrub grass woodlands of the Narrabri–Yetman region, Brigalow Belt South Bioregion	N/A	N/A	N/A	N/A
PCT 628 Carbeen +/- Coolabah grassy woodlands on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	N/A	Present	N/A

Further information related to landscape feature and vegetation communities is provided in Appendix B: Biodiversity Technical Report.

11.5.2 Flora

A total of 339 flora species were recorded within the subject land. Of those, 283 (83 per cent) were native and 56 (17 per cent) were non-native. Of the native species, none were species-credit species. No species-credit or ecosystem-credit flora species or EPBC Act listed flora species were observed within the subject land. A full list of the species recorded within the subject land is provided in Appendix B: Biodiversity Technical Report.

A total of seven threatened flora species identified under the provisions of the BC Act and EPBC Act are predicted to possibly or likely occur within the subject land outside of the BAM calculator-generated reports. A full list of BC Act species predicted to occur within the subject land is provided in Appendix B: Biodiversity Technical Report.

11.5.3 Fauna

A total of 207 fauna species were observed within the subject land, including nine (4 per cent) non-native species. Observed species consisted of 145 birds, 37 mammals, 20 reptiles and five amphibians. A full list of fauna species recorded within the study area is provided within Appendix B: Biodiversity Technical Report. EPBC Act listed species observed within the study area and adjacent area included Australasian bittern (*Botaurus poiciloptilus*), white-bellied sea-eagle (*Haliaeetus leucogaster*), painted honeyeater (*Grantiella picta*), koala (*Phascolarctos cinereus*), grey-headed flying fox (*Pteropus poliocephalus*), and Latham's snipe (*Gallinago hardwickii*).

11.5.3.1 Ecosystem credit species under the biodiversity assessment method

Fifty ecosystem-credit species are predicted to occur (through the BAM C) across all assessment areas within the subject land. Although targeted surveys for ecosystem-credit species are not required in accordance with the BAM, some of these species were incidentally identified during the surveys undertaken within the subject land as listed below. Within the BAM Calculator¹ some assessment was made on the likelihood of those species occurring based on whether or not critical habitat features were present within the PCT zone. Where species required trees and the PCT quality was such that no or very few (<1 tree per 0.5 ha) trees were present, then the species was determined not to occur within that area (i.e. koala or painted honeyeater); however, if the species uses trees but may forage in open areas, they were assumed present within areas of the PCT in which they were predicted, even where trees did not occur (i.e. varied sittella).

A list of these occurrences and the habitat assumptions is located in Appendix B: Biodiversity Technical Report.

Eleven ecosystem-credit species were identified within the subject land and adjacent areas during the field assessment (refer Figure 11.4), including:

- ▶ Australian bittern (*Botaurus poiciloptilus*)
- ▶ White-bellied sea-eagle (*Haliaeetus leucogaster*)
- ▶ Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
- ▶ Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- ▶ Little pied bat (*Chalinolobus picatus*)
- ▶ Yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*)
- ▶ Northern free-tailed bat (*Mormopterus lumsdenae*)
- ▶ Corben's long-eared bat (*Nyctophilus corbeni*) (possible ID from call analysis)
- ▶ Grey-headed flying-fox (*Pteropus poliocephalus*)
- ▶ Spotted harrier (*Circus assimilis*)
- ▶ Scarlet robin (*Petroica boodang*).

1. An online application of the BAM, which uses the rules and calculations outlined in the BAM and allows the user to apply the BAM at a site and observe the results of the assessment.

11.5.3.2 Species credit species under the Biodiversity Assessment Method

Fifty-three species credit species are predicted to occur across the assessment areas within the subject land. The BAM Calculator included an assessment of the likelihood of those species occurring based on the presence or absence of critical habitat features within the PCT zone. Where species required trees and the PCT condition was low (no mature trees) the species was considered absent within that vegetation zone (i.e. koala or painted honeyeater); however, if the species requires trees but also forages in open areas, presence was assumed in associated PCTs in low condition (i.e. varied sittella). A list of these occurrences and the habitat assumptions is located in Appendix B: Biodiversity Technical Report.

Two species-credit fauna species were identified within the subject land during the field assessment (refer Figure 11.5), including:

- ▶ Squirrel glider (*Petaurus norfolcensis*)
- ▶ Koala (*Phascolarctos cinereus*).

No breeding places in use by species-credit fauna species were observed in the study area. No other records of species credit species are known to occur within the subject land.

A full list of species-credit species, migratory species and other native species predicted to occur or recorded during field surveys is provided in Appendix B: Biodiversity Technical Report.

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
 Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

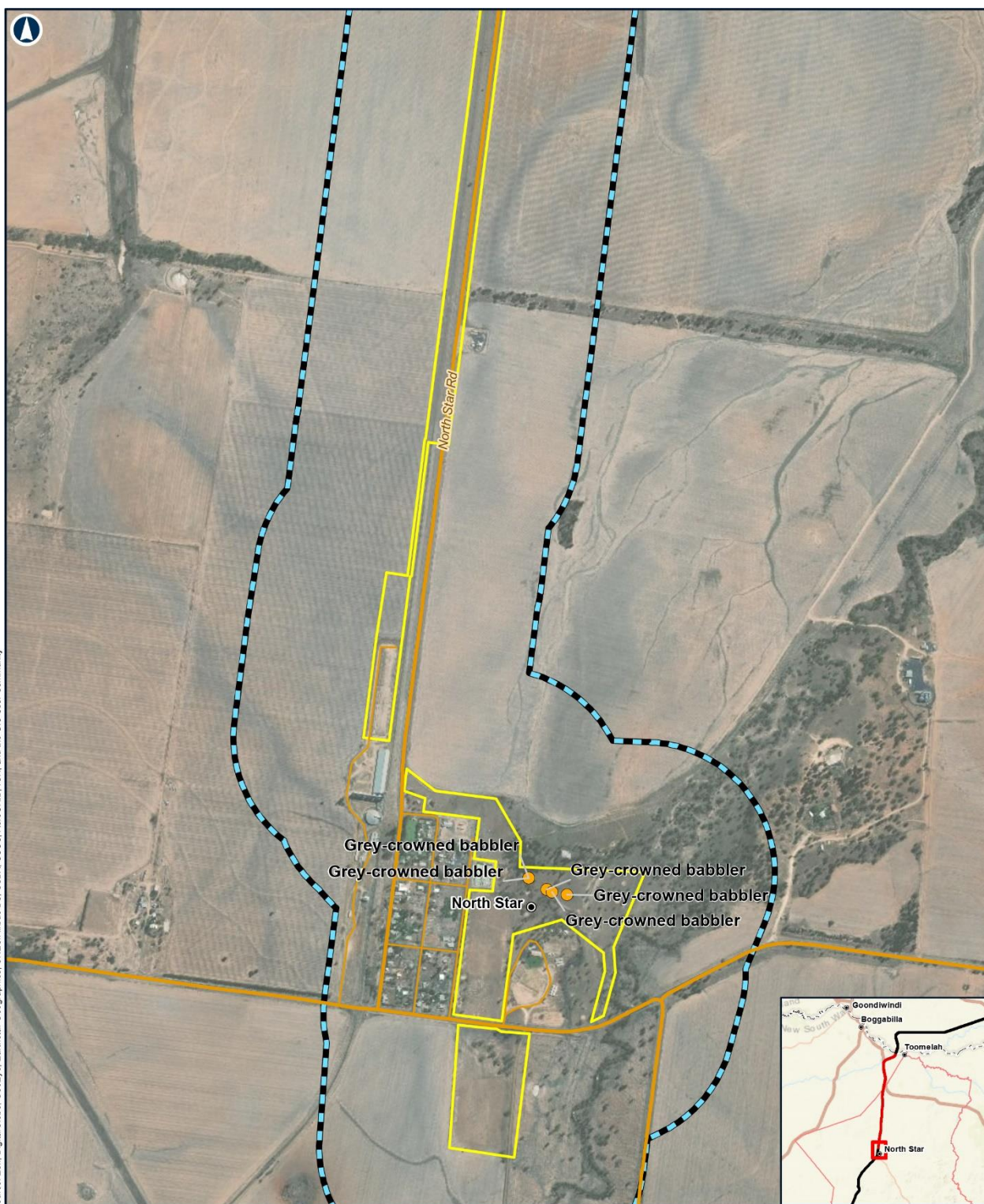


Figure 11.4a: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

0.6 km

Coordinate System: GDA 1994 MGA Zone 56

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LEGEND

- Fauna observations
- Localities
- Major roads
- Minor roads
- Subject land
- ▭ Study area

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FIGURE 11.4A-MLOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
 Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

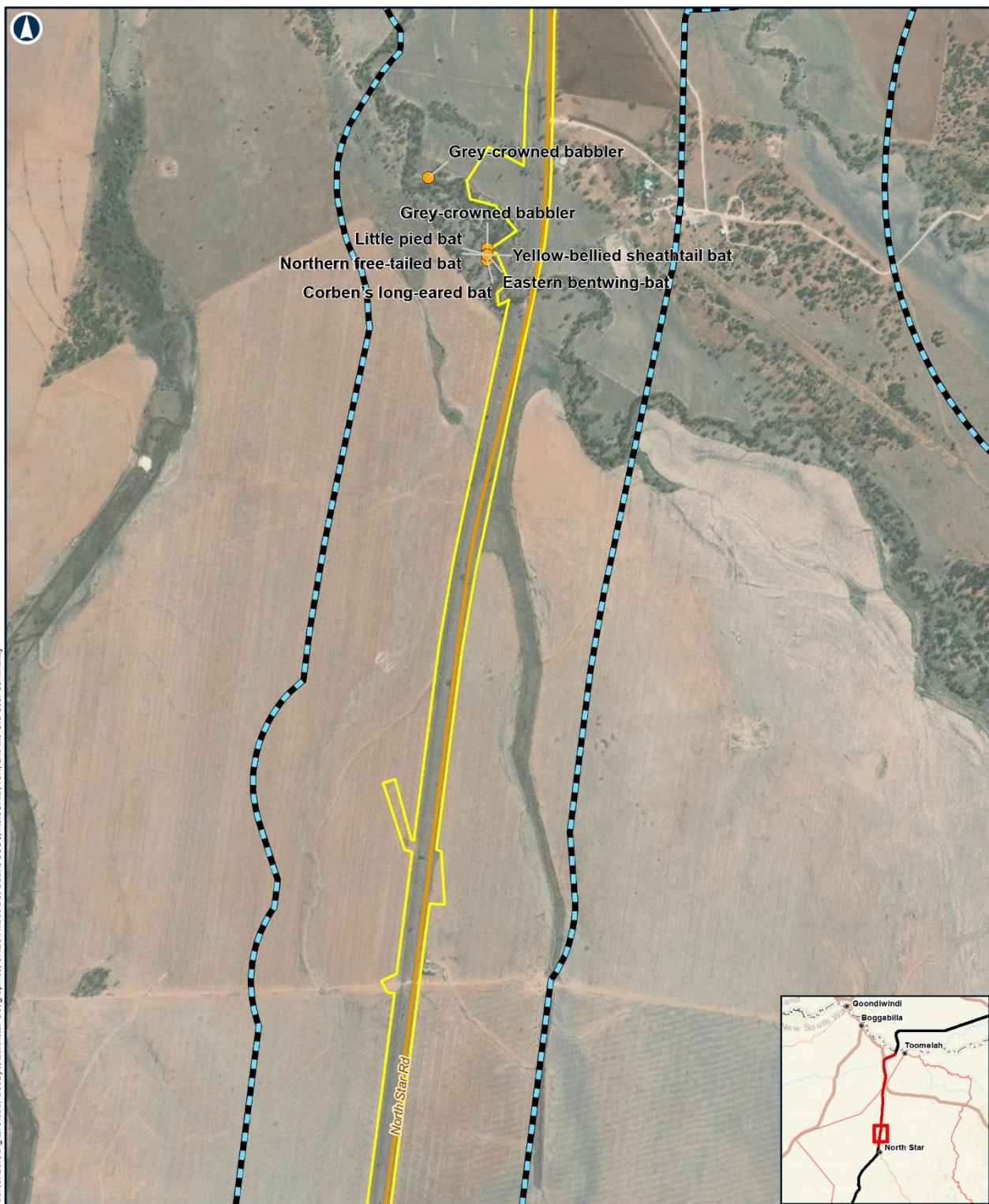


Figure 11.4b: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

0.6 km

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LEGEND

- Fauna observations
- Major roads
- Subject land
- Study area

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FIGURE 11.4B LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

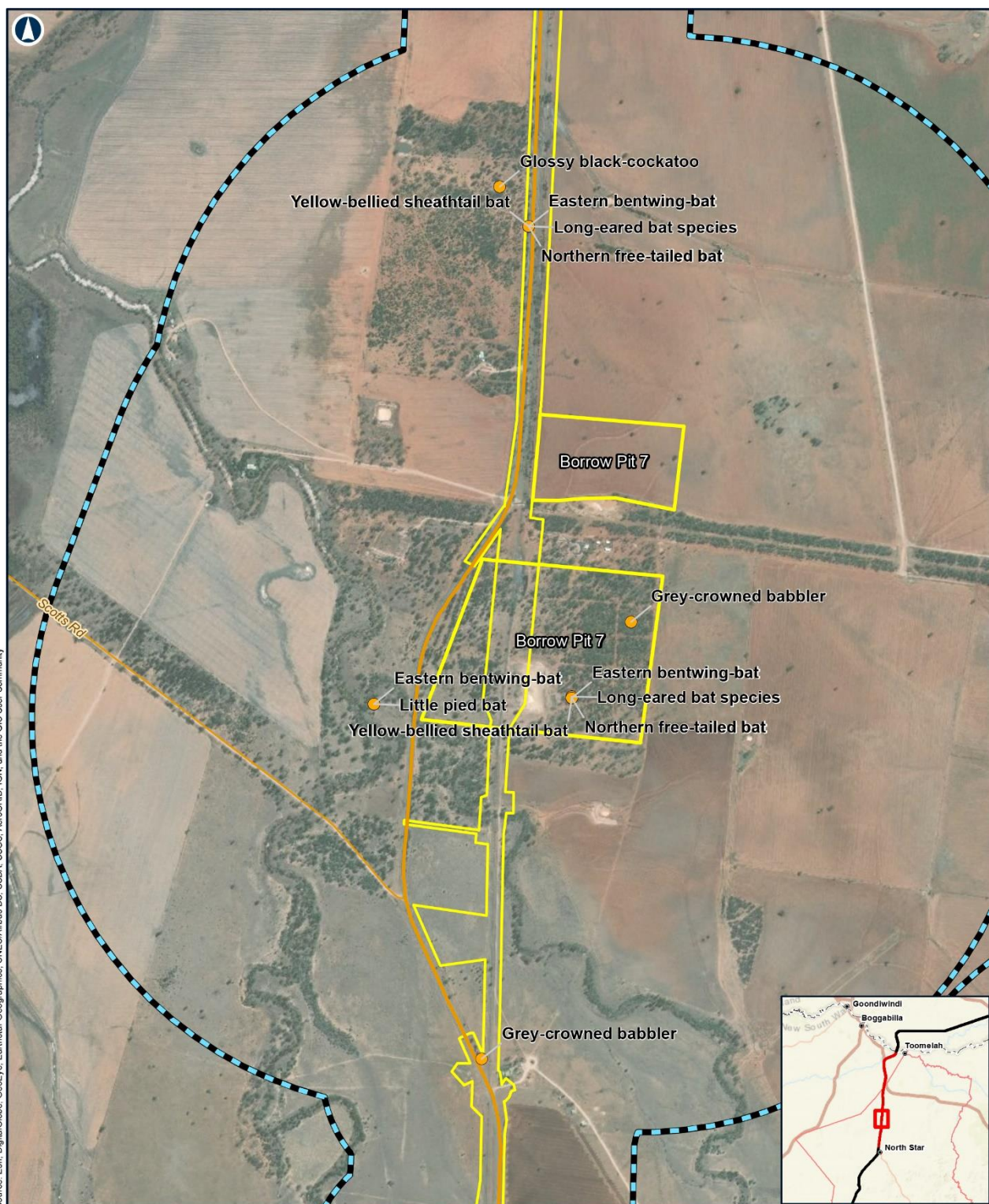


Figure 11.4c: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

0.6 km

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LEGEND

- Fauna observations
- Major roads
- Minor roads
- Subject land
- Study area

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FIGURE 11.4C LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

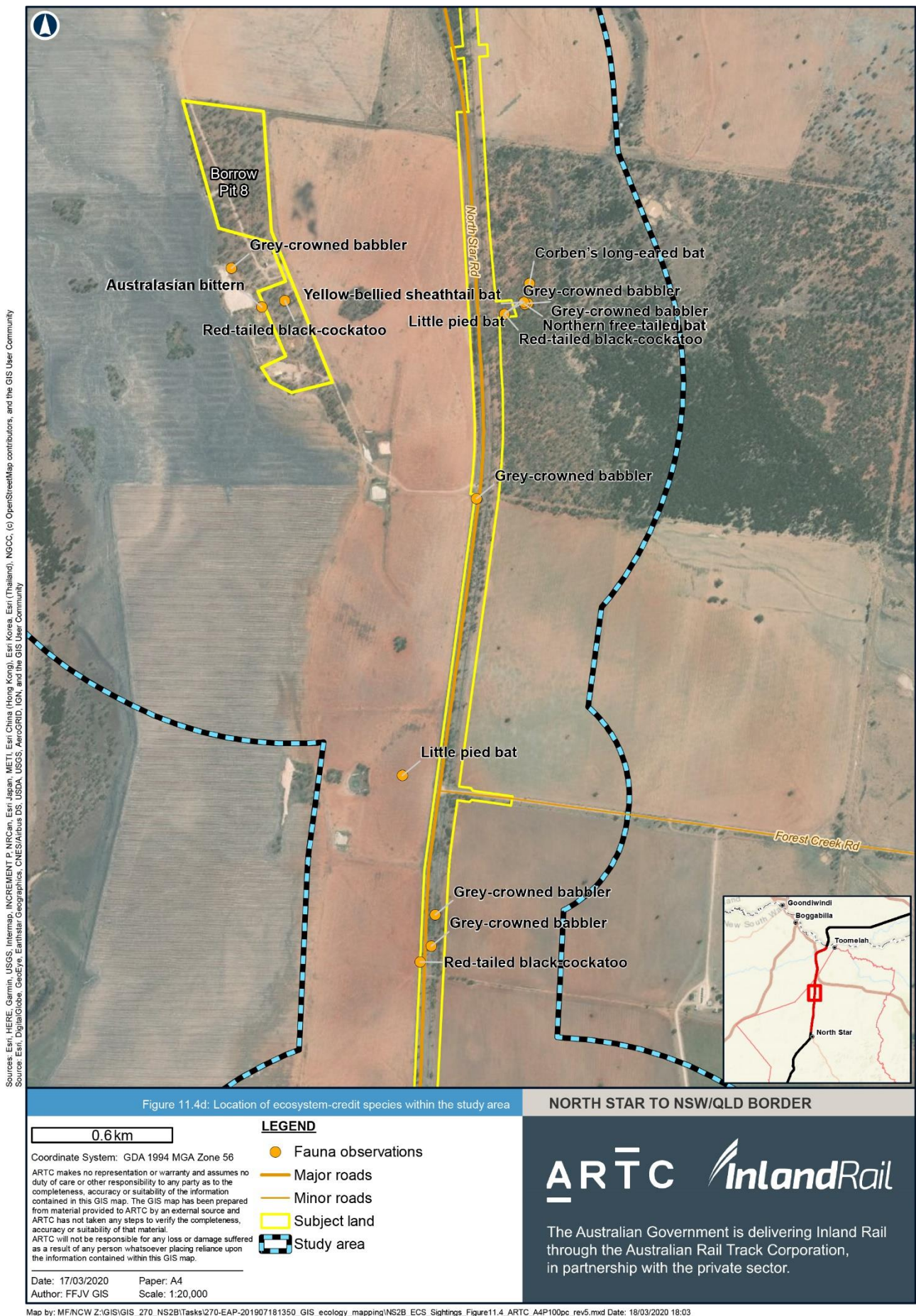


FIGURE 11.4D LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

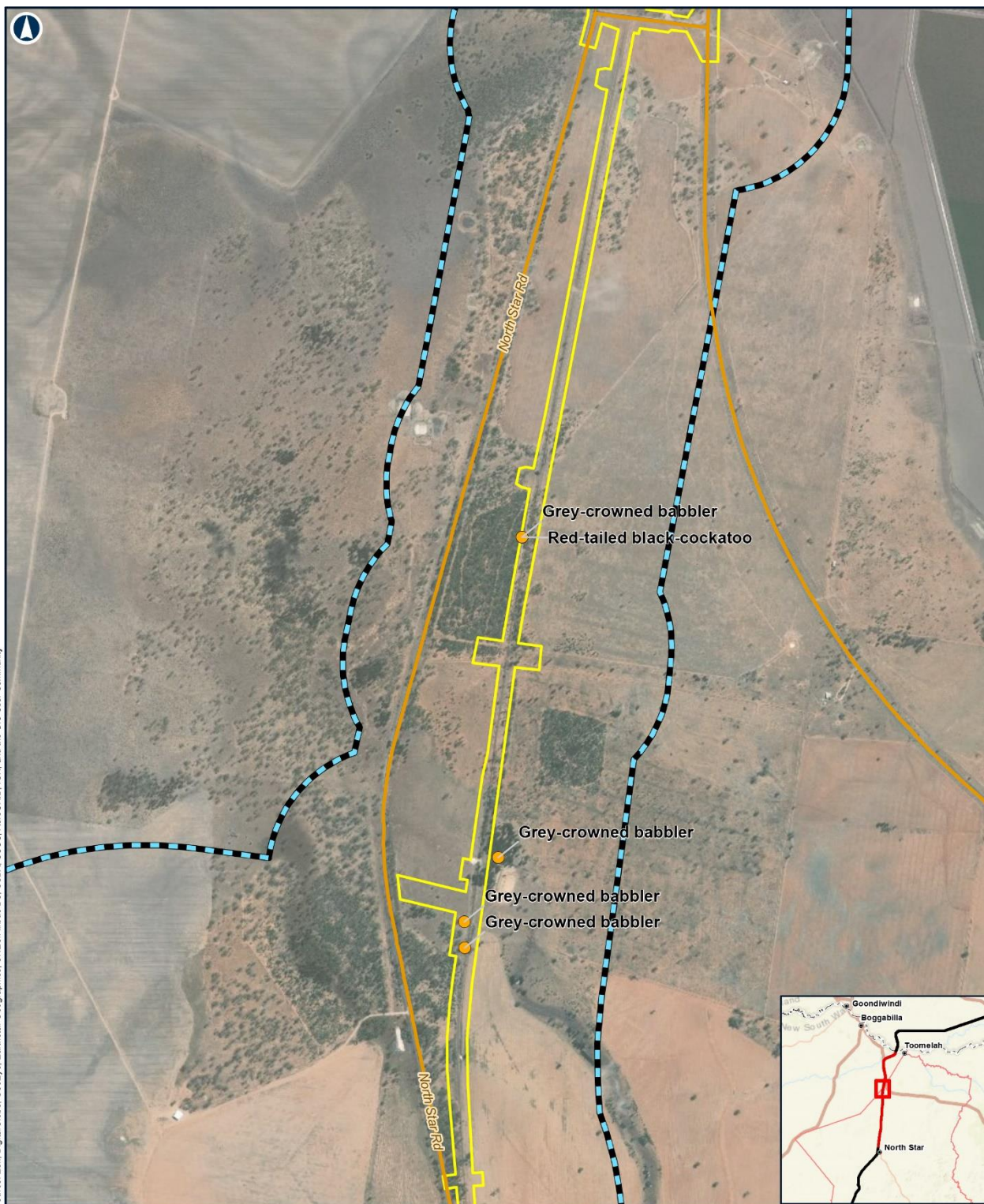


Figure 11.4e: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

0.6 km

LEGEND

- Fauna observations
- Major roads
- Minor roads
- Subject land
- ▬ Study area

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FIGURE 11.4E LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
 Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

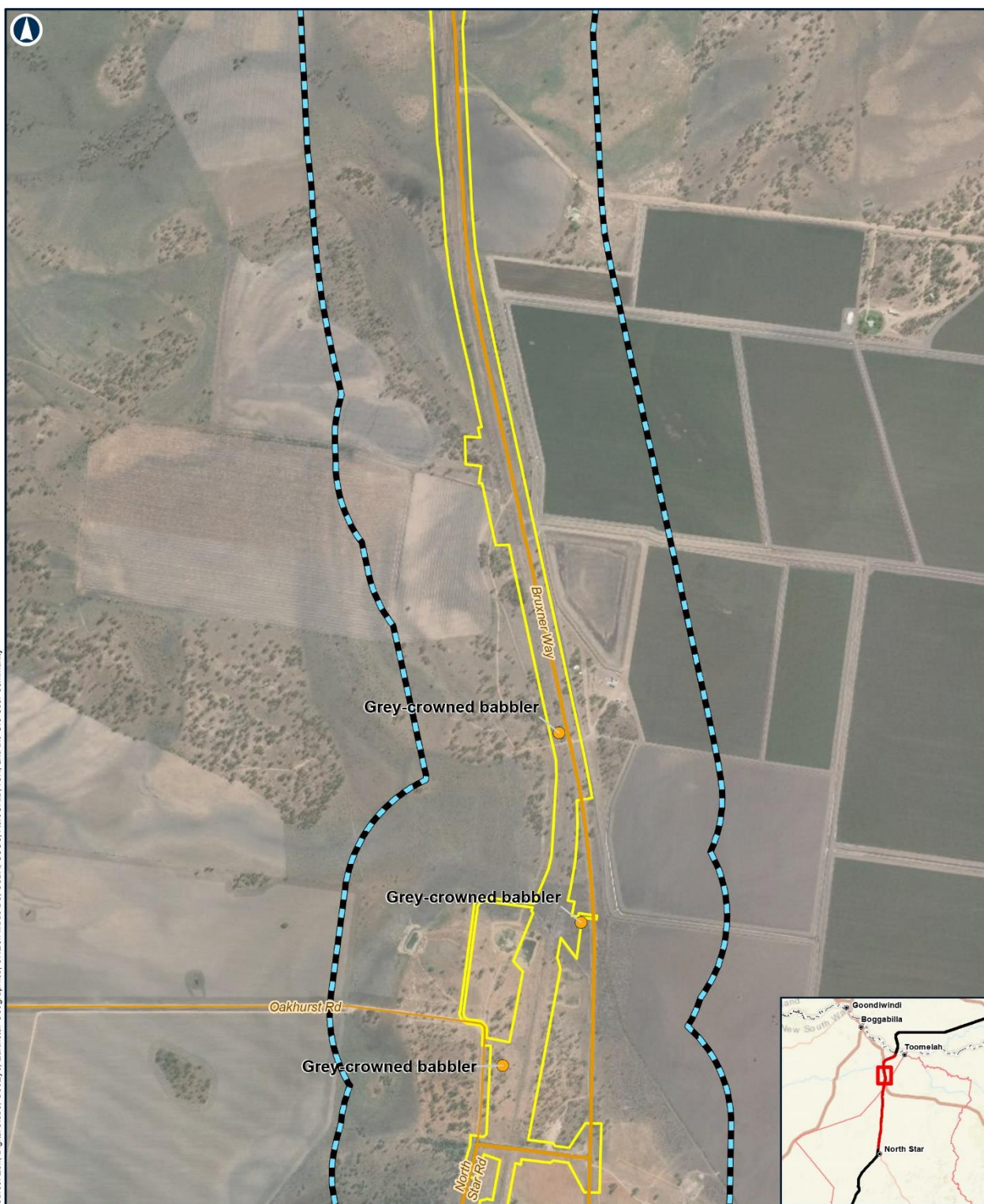


Figure 11.4f: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

LEGEND

- Fauna observations
- Major roads
- Minor roads
- Subject land
- ▬ Study area

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FIGURE 11.4F LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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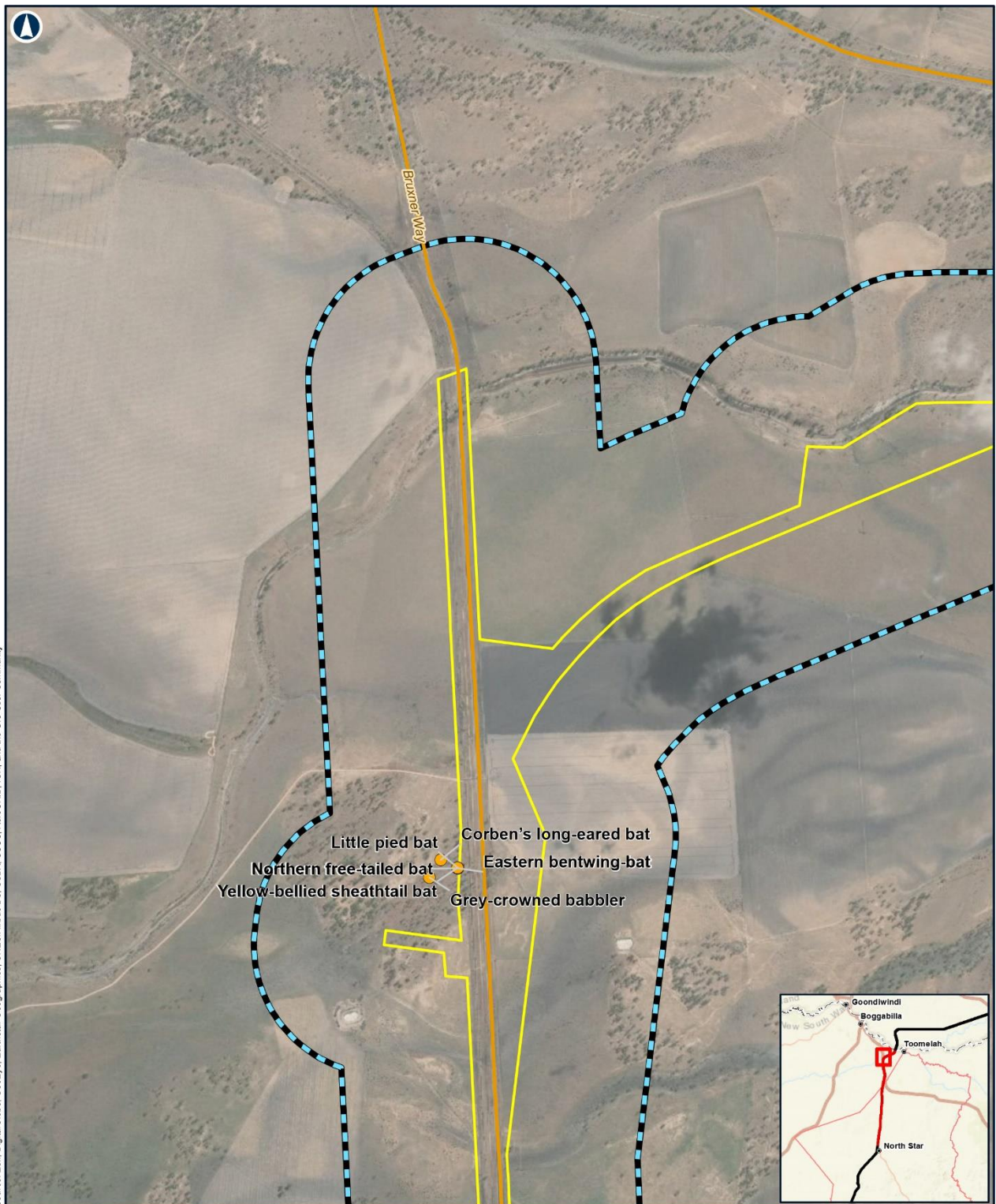


Figure 11.4g: Location of ecosystem-credit species within the study area

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LEGEND

- Fauna observations
- Major roads
- Subject land
- ▬ Study area

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FIGURE 11.4G LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

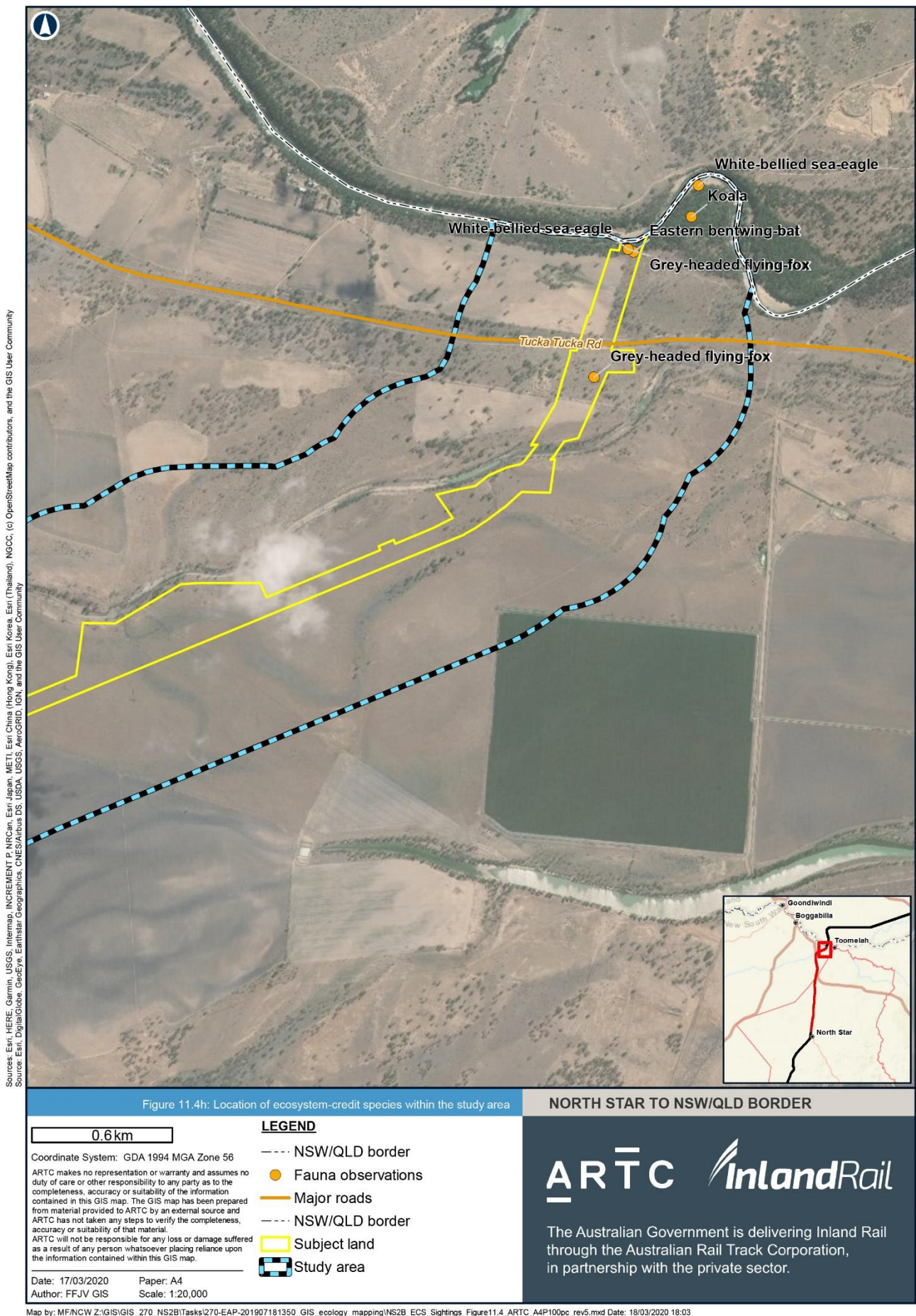


FIGURE 11.4H LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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Figure 11.4i: Location of ecosystem-credit species within the study area

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LEGEND

- Fauna observations
- Major roads
- Subject land
- Study area

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FIGURE 11.4I LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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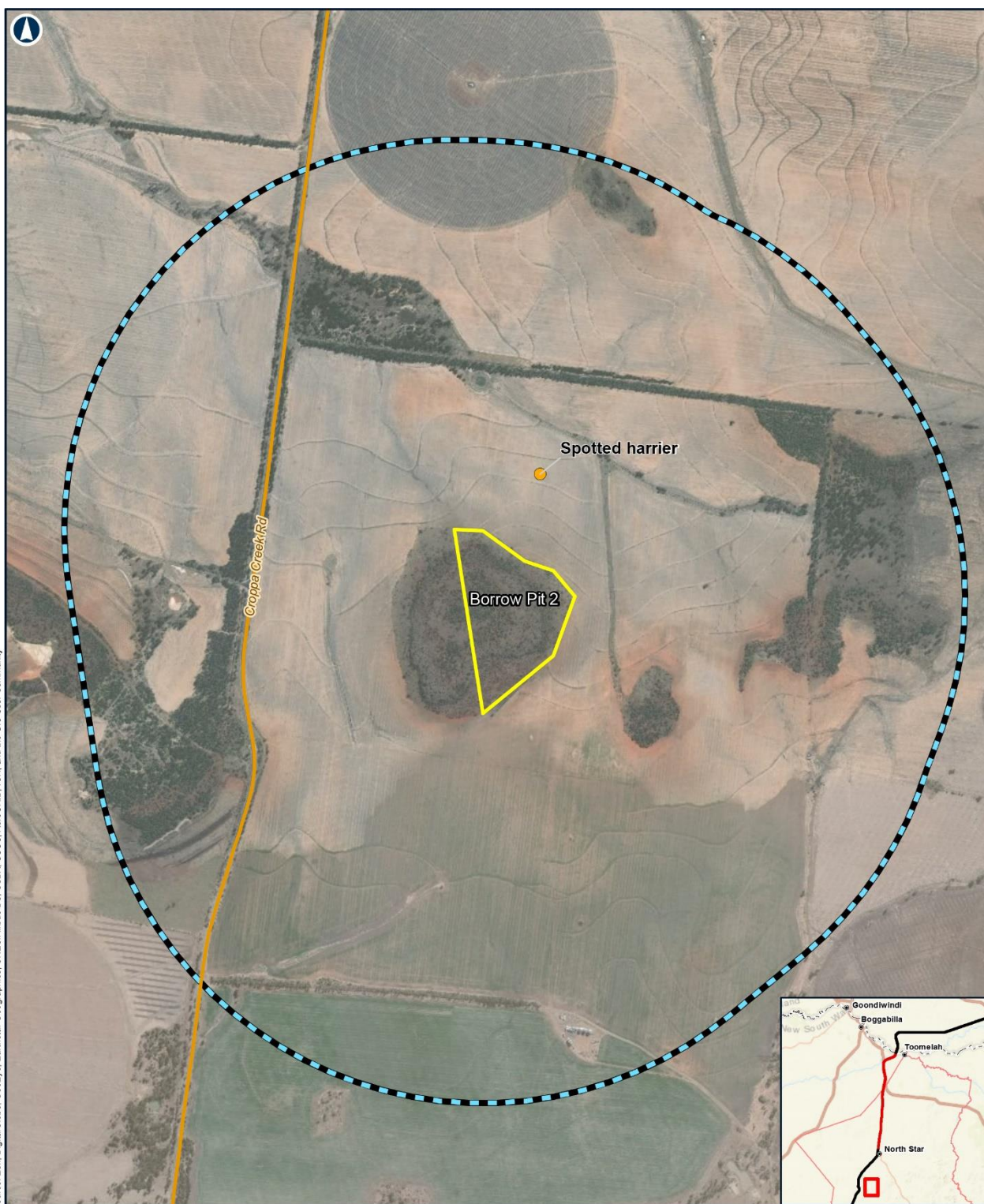


Figure 11.4j: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

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LEGEND

- Fauna observations
- Major roads
- Subject land
- Study area

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FIGURE 11.4J LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
 Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

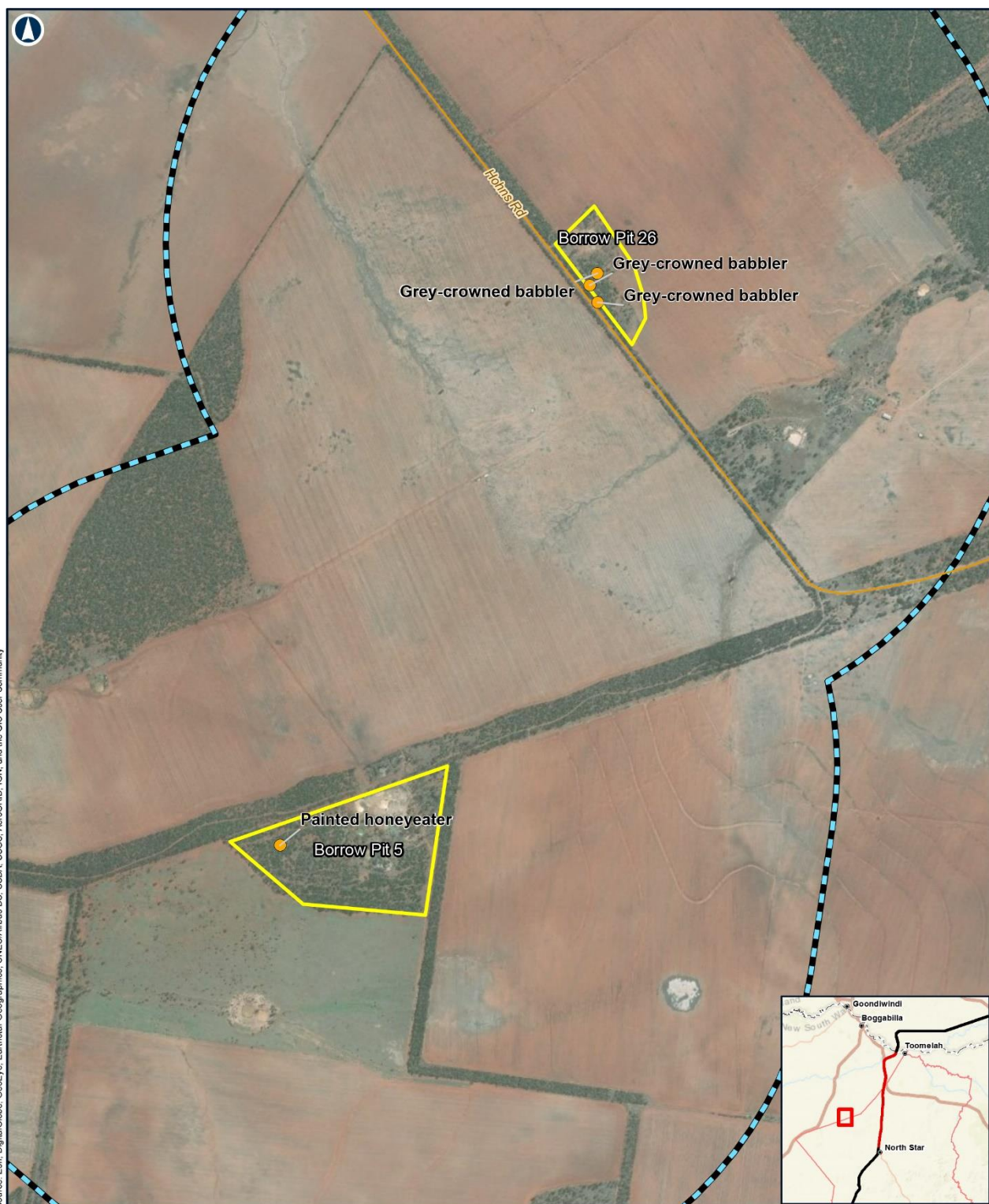


Figure 11.4k: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

0.6 km

LEGEND

- Fauna observations
- Minor roads
- Subject land
- ▨ Study area

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FIGURE 11.4K LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
 Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

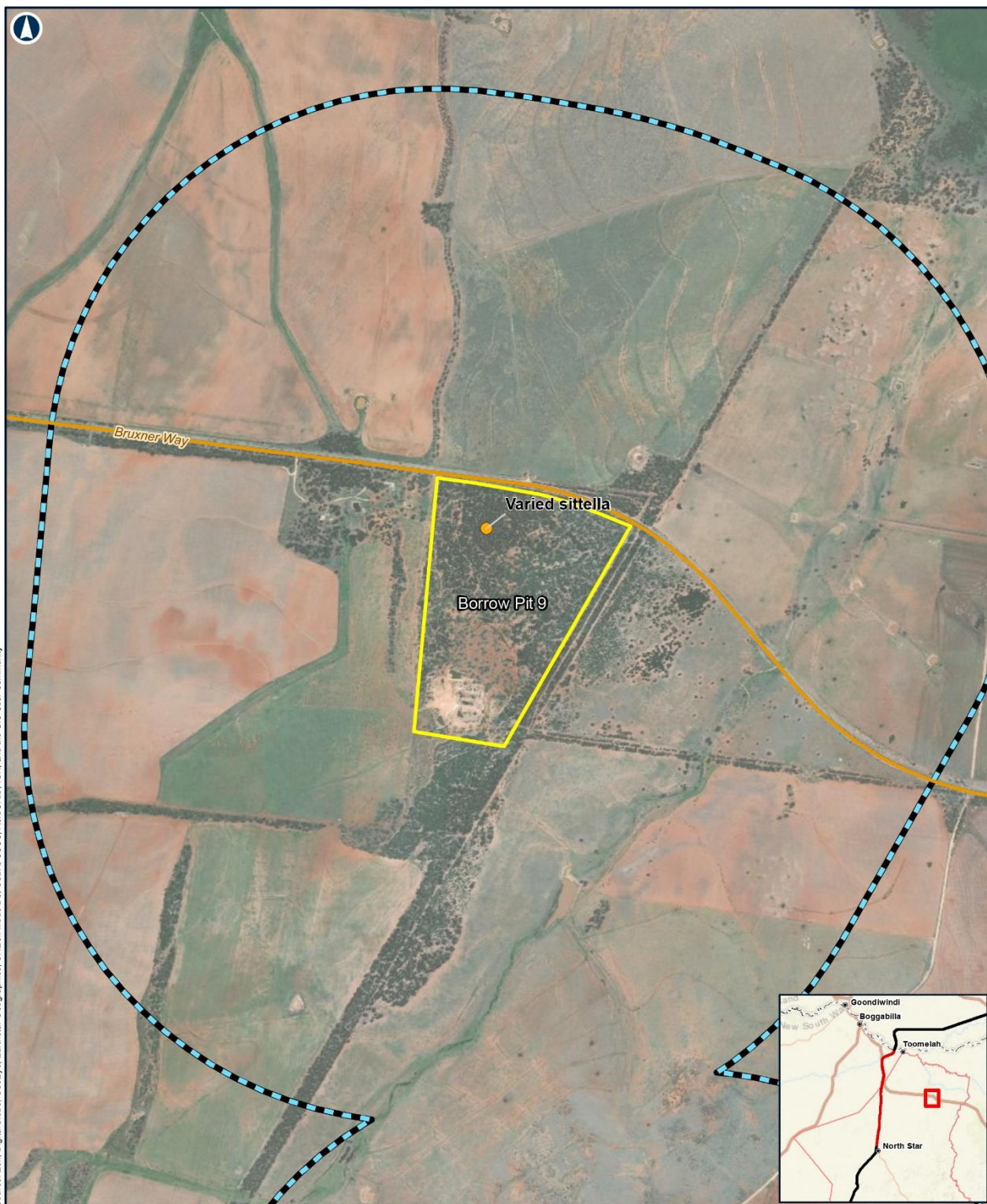


Figure 11.4I: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

0.6 km

Coordinate System: GDA 1994 MGA Zone 56

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LEGEND

- Fauna observations
- Major roads
- Subject land
- Study area

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FIGURE 11.4L LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
 Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

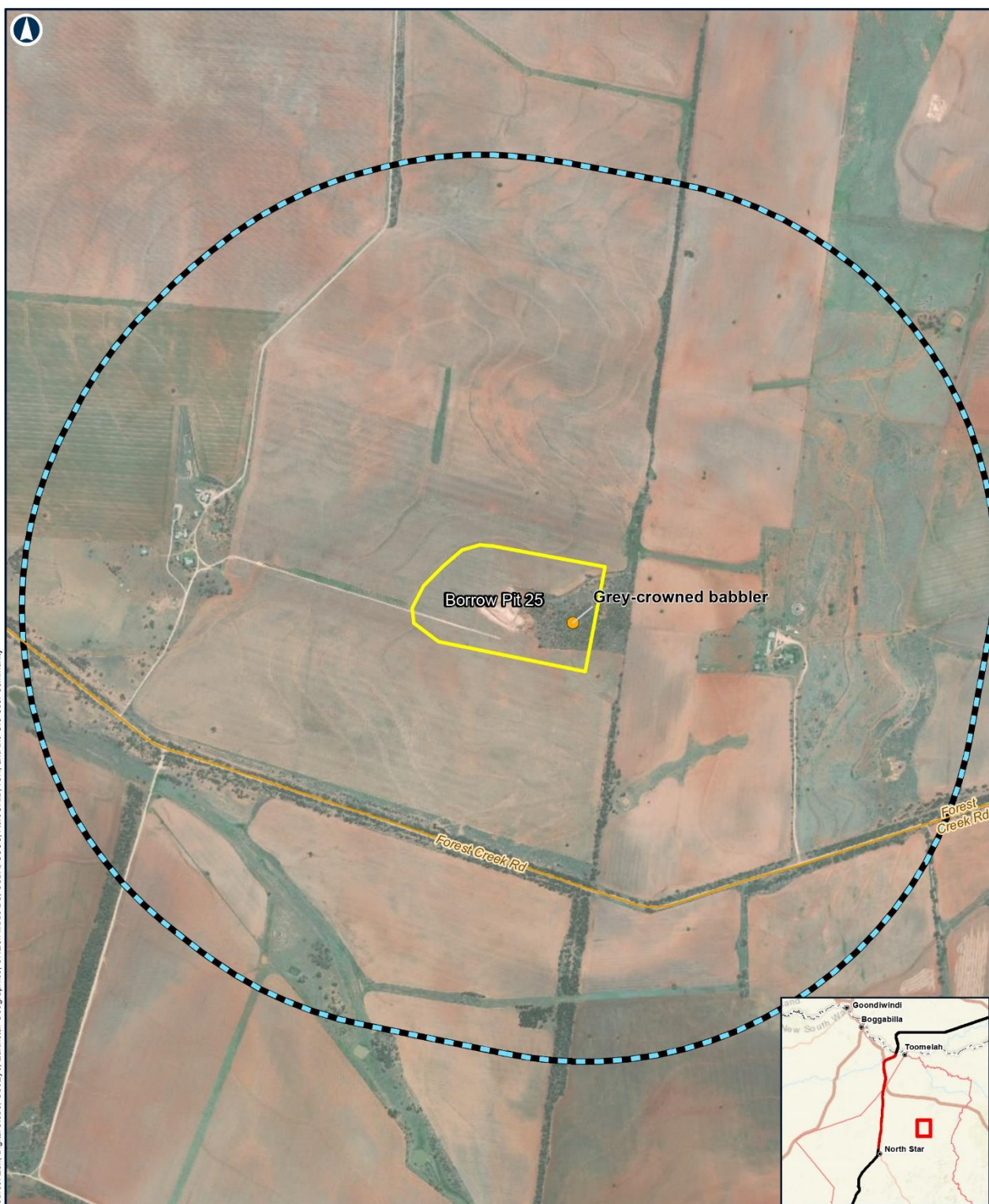


Figure 11.4m: Location of ecosystem-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

0.6 km

Coordinate System: GDA 1994 MGA Zone 56

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LEGEND

- Fauna observations
- Minor roads
- Subject land
- Study area

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FIGURE 11.4M LOCATION OF ECOSYSTEM-CREDIT SPECIES WITHIN THE STUDY AREA



Figure 11.5: Location of species-credit species within the study area

NORTH STAR TO NSW/QLD BORDER

6km

LEGEND

- Localities
- Fauna observations
- Major roads
- Minor roads
- NSW/QLD border
- Subject land
- Study area

Coordinate System: GDA 1994 MGA Zone 56
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 Author: FFJV GIS Scale: 1:200,000

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FIGURE 11.5 LOCATION OF SPECIES CREDIT SPECIES WITHIN THE STUDY AREA

11.5.3.3 Threatened and migratory fauna

Fauna species listed as threatened under the BC Act and/or EPBC Act or listed as migratory under the EPBC Act which have been observed within the study area and adjacent areas during site investigations are detailed in Table 11.8.

TABLE 11.8 THREATENED AND MIGRATORY SPECIES OBSERVED WITHIN THE STUDY AREA AND ADJACENT AREA

Family	Species name	Common name	BC Act status	EPBC Act status
Ardeidae	<i>Botaurus poiciloptilus</i>	Australasian bittern	E, P	E
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned babbler	V, P	–
Accipitridae	<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	V, P	Ma
Cacatuidae	<i>Calyptorhynchus banksii samueli</i>	Red-tailed black-cockatoo (inland subspecies)	V, P	–
Cacatuidae	<i>Calyptorhynchus lathami</i>	Glossy black-cockatoo	V	–
Meliphagidae	<i>Grantiella picta</i>	Painted honeyeater	V	V
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied sittella	V	–
Petauridae	<i>Petaurus norfolcensis</i>	Squirrel glider	V, P	–
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	V	V
Vespertilionidae	<i>Nyctophilus corbeni</i>	Corben's long-eared bat	V, P	–
Vespertilionidae	<i>Miniopterus orianae oceanensis</i>	Eastern large-winged bat	V, P	–
Miniopteridae	<i>Miniopterus schreibersii oceanensis</i>	Eastern bentwing-bat	V	–
Molossidae	<i>Mormopterus lumsdenae</i>	Northern free-tailed bat	V	–
Vespertilionidae	<i>Chalinolobus picatus</i>	Little pied bat	V, P	–
Molossidae	<i>Mormopterus lumsdenae</i>	Northern free-tailed bat	V, P	–
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied sheath-tail-bat	V, P	–
Molossidae	<i>Setirostris eleryi</i>	Bristle-faced free-tailed bat	V, P	–
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed flying fox	V	V
Scolopacidae	<i>Gallinago hardwickii</i>	Latham's snipe	P	M
Accipiter	<i>Circus assimilis</i>	Spotted harrier	V	–
Petroicidae	<i>Petroica boodang</i>	Scarlet robin	V	–
Percichthyidae	<i>Maccullochella peelii</i>	Murray cod*	–	V

Table notes:

P=Protected, V=Vulnerable, E=Endangered, M=Migratory, Ma=Marine

The ultrasonic bat call detectors identified one or more *Nyctophilus* species within the subject land (the *Nyctophilus* genus cannot be identified to species level from their calls). Three species potentially occur in the subject land: *Nyctophilus geoffroyi*, *Nyctophilus gouldi* and the Vulnerable *Nyctophilus corbeni*, which is an ecosystem credit species, *=refer Section 11.5.4.

11.5.4 Aquatic habitat, quality and threatened species

The subject land falls within the Border Rivers Catchment which comprise the catchments of the Dumaresq, Severn and Macintyre Rivers. The proposal falls within the Macintyre River sub-catchment. Assessments were undertaken at several locations along streams that intersected the study area (refer Section 11.4.3.2). The stream orders of waterways within the study area are presented and the habitat scores from the AUSRIVAS assessments are presented in Table 11.9. The location of waterways in context of the proposal is illustrated in Appendix S: Aquatic Biodiversity Technical Report Technical Report.

TABLE 11.9 STRAHLER ORDER BY WATERWAY AND AUSRIVAS HABITAT SCORES

Waterway	Strahler order	AUSRIVAS habitat scores			Alignment intersect coordinates	
		Upstream	Intersecting alignment	Downstream	Easting	Northing
Mobbindry Creek	3	95	62	84	246684.00 m E	6803707.00 m S
Back Creek	3	91	129	94	246781.00 m E	6806005.00 m S
Whalan Creek	2	93	81	–	250661.00 m E	6825475.00 m S
Macintyre River	6	152	135	–	251053.00 m E	6826350.00 m S
Unnamed tributary of Mobbindry Creek	1/2	48	64	–	246495.00 m E	6802878.00 m S
Forest Creek	3	26	39	69	247179.00 m E	6814447.00 m S

First and second order streams (based on the Strahler method of stream ordering) are not considered key fish habitat unless they are found to be habitat of a listed threatened species, population or community DPE, 2013). The unnamed tributary of Mobbindry Creek is considered to be both a first and second order stream depending on the section of the reach assessed.

The proposal intersects key fish habitat areas (sensitivity classification scheme) including several Type 1 fish habitat areas (highly sensitive):

- ▶ Macintyre River
- ▶ Whalan Creek
- ▶ Back Creek
- ▶ Mobbindry Creek.

No Type 2 fish habitats (moderate sensitive habitat) intersect the proposal.

The proposal also intersects two Type 3 fish habitat areas (minimal sensitive habitat):

- ▶ Forest Creek
- ▶ Unnamed tributary of Mobbindry Creek.

No fish records occur within the rail corridor identified in a search of the BioNet database.

The only threatened aquatic species identified by the Protected Matters Search Tool was the Murray cod (*Maccullochella peelii*), which is listed as vulnerable (EPBC Act). The Murray cod was captured within the Macintyre River during field investigation undertaken for the Inland Rail Border to Gowrie Project. The Macintyre River provides suitable habitat for Murray cod. The Macintyre River is identified as an important population for the Murray cod (National Murray cod Recovery Team, 2010). All other waterways surveyed are unlikely to support Murray cod due to a lack of key fish habitat, including, but not limited to, semi-permanence of aquatic refuges. No aquatic communities were identified in the Protected Matters Search Tool report.

In the absence of species records the status of threatened species was informed by a review of resources prepared by the DPI NSW. The Border Rivers Water Resources and Management Overview (Green et al., 2012) identifies three threatened aquatic species that may be found within the broader catchment: the Darling River snail (*Notopala sublineata*), silver perch (*Bidyanus bidyanus*), and the southern purple spotted gudgeon (*Mogurnda adspersa*).

There is one endangered population, olive perchlet (*Ambassis agassizii*) western population, and one endangered ecological community, the Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River. The Darling River endangered ecological community includes all native fish and aquatic invertebrates within the natural creeks, rivers and streams, lagoons, billabongs, lakes, flow diversions to anabranches, and the flood plains of the Darling River. It also includes the Macintyre River within the rail corridor. A likelihood of occurrence assessment for potential aquatic ecological receptors determined that the Silver perch was unlikely to occur within or adjacent to the subject land, including the Macintyre River proximal to the subject land (refer Appendix S: Aquatic Biodiversity Technical Report Technical Report).

The freshwater threatened species distribution maps prepared by DPI are based on survey records, predicted occurrence and expert opinion. The maps indicate there are a number of state-listed species that are potentially present in the Macintyre River (including the Darling population of the eel-tailed catfish (*Tandanus tandanus*); however, this population is not listed in Green et al. (2012). Other waterways associated with the proposal (i.e. Mobbindry, Whalan and Back Creek) are also mapped as potential habitat for protected species and it is possible that these species use the habitat when conditions and connectivity permit accessibility.

Field investigations undertaken within the subject land did not record any threatened aquatic fauna.

Field investigations undertaken to support the EIS for the Border to Gowrie project in the Macintyre River recorded eight native species of fish, including two threatened species:

- ▶ Murray cod (*Maccullochella peelii*)
- ▶ Western olive perchlet (*Ambassis agassizii*).

11.5.5 Weeds and pests

Fifty-six non-native plant species were observed within the study area. Of these, 34 (61 per cent) are recorded as 'naturalised' on PlantNET, 15 (27 per cent) are listed as high-threat exotics and four (7 per cent) do not appear on the PlantNET records for NSW. One high-threat exotic was recorded outside of the subject land but has the potential to invade within a short timeframe. A full list of the weed species recorded within the subject land is provided in Appendix B: Biodiversity Technical Report. No aquatic pest species were observed.

Ten pest fauna species were identified within the subject land, including:

- ▶ Feral cat (*Felis catus*)
- ▶ Pig (*Sus scrofa*)
- ▶ European rabbit (*Oryctolagus cuniculus*)
- ▶ European fox (*Vulpes vulpes*)
- ▶ European hare (*Lepus europaeus*)
- ▶ Dog (*Canis lupus*)
- ▶ Camel (*Camelus dromedarius*)
- ▶ Rock dove (*Columba livia*)
- ▶ Common myna (*Sturnus tristis*)
- ▶ Common starling (*Sturnus vulgaris*).

11.5.6 Critical habitats

No areas of critical habitat listed on the Register of Critical Habitat (EPBC Act) occurs within or adjacent to the study area. A single area of critical habitat under Division 3 of the FM Act has been registered. This is grey nurse shark critical habitat, which is a marine environment and not relevant to the proposal.

11.5.7 Waterfront land

Under the *NSW Water Management Act 2000* (NSW) 'waterfront land' is defined as the bed of a river and the land within 40 m of the riverbank. Within the proposal area, the Macintyre River and adjacent lands are therefore classed as waterfront land. Under the Act this may be classed as a 'controlled activity' requiring development approval. The guidelines for controlled activities on waterfront land (DPI, 2012) provide a framework for development activities within the riparian corridor; however, the proposal has been classed as SSI and is exempt from requiring a controlled activity approval. As such, waterfront land associated with the proposal is not referred to further in this report. Description of riparian and aquatic habitats associated with these areas are discussed in Section 11.5.4.

11.5.8 Protected area and offset sites

No protected areas (including land and water) managed by OEH and/or DPI Fisheries under the *National Parks and Wildlife Act 1974* (NSW) and the *Marine Estate Management Act 2014* (NSW) have been identified within the study area. Biobank sites, private conservation lands and other lands identified as offsets have also not been identified within the study area.

11.6 Matters specific to matters of national environmental significance

11.6.1 Matters identified within the study area

The following MNES species and TECs were identified within, or in close proximity to, the subject land:

- ▶ Corben's long-eared bat (*Nyctophilus corbeni*)²
- ▶ Australasian bittern (*Botaurus poiciloptilus*)
- ▶ White-bellied sea-eagle (*Haliaeetus leucogaster*)
- ▶ Painted honeyeater (*Grantiella picta*)
- ▶ Koala (*Phascolarctos cinereus*)
- ▶ Grey-headed flying fox (*Pteropus poliocephalus*)
- ▶ Latham's snipe (*Gallinago hardwickii*)
- ▶ Murray cod (*Maccullochella peelii*)
- ▶ Weeping Myall woodlands TEC
- ▶ Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC
- ▶ Poplar box woodlands on alluvial soils TEC
- ▶ Natural grasslands on basalt and fine-textured alluvial plains of Northern NSW and Southern Queensland TEC.

11.6.2 Matters not within the study area

The following MNES were not identified within, or in close proximity to, the subject land:

- ▶ World heritage areas
- ▶ National heritage places
- ▶ Wetlands of international importance
- ▶ Commonwealth marine areas
- ▶ Great Barrier Reef Marine Park
- ▶ Nuclear actions
- ▶ A water resource, in relation to coal seam gas development and large coal mining development.

11.7 Ecological receptors

The ecological receptors identified for terrestrial and aquatic ecology within the subject land are identified in Table 11.10, along with their assigned sensitivity value. In addition to their assigned sensitivity, the impact assessment pathway is identified in Table 11.10 as described in Section 11.4.4.

Ecological receptors regulated under the BC Act were identified through the BAM. Ecological receptors regulated under the EPCB Act and FM Act were identified through desktop searches, habitat assessment and likelihood of occurrence assessment. Potential ecological receptors regulated under the EPBC Act or FM Act were excluded if their occurrence was considered unlikely or predictive habitat mapping did not identify suitable habitat within the subject land. These species were not subject to impact assessment and were no longer considered to constitute ecological receptors because the risk of impacts to any of these species are considered low.

2. The ultrasonic bat call detectors identified one or more *Nyctophilus* species within the subject land (the *Nyctophilus* genus cannot be identified to species level from their calls). Three species potentially occur in the subject land: *Nyctophilus geoffroyi*, *Nyctophilus gouldi* and the vulnerable *Nyctophilus corbeni*, which is an ecosystem credit species.

TABLE 11.10 IDENTIFIED ECOLOGICAL RECEPTORS WITHIN THE STUDY AREA

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ NSW natural environment and native flora and fauna ▶ Biodiversity 	EPBC Act listed communities: <ul style="list-style-type: none"> ▶ Brigalow (<i>Acacia harpophylla</i>) dominant and co-dominant) community ▶ Weeping Myall open woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions ▶ Natural grasslands on basalt and fine-textured alluvial plains of northern NSW (NSW) and southern Queensland ▶ Poplar box grassy woodlands on alluvial plains ▶ Semi-evergreen vine thickets of the Brigalow Belts (North and South) and the Nandewar bioregions ▶ Weeping myall open woodlands of the Darling Riverine Plains and Brigalow Belt South bioregions. 	High	<ul style="list-style-type: none"> ▶ Conservation significant: protected by EPBC Act ▶ Relatively intact: TEC generally comprised of relatively good condition vegetation ▶ Unique to the environment: TECs are unique to the region ▶ Poorly represented in the region: the extent TECs in the region has been significantly reduced from their former extent ▶ Proposal activities would have an adverse impact on TECs: vegetation clearing within TECs would remove TECs. 	SIAM
	BC Act Threatened Ecological Communities (Critically endangered and endangered): <ul style="list-style-type: none"> ▶ Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains bioregions ▶ Carbeen open forest community in the Darling Riverine Plains and Brigalow Belt South bioregions ▶ Myall woodlands in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray–Darling Depression, Riverina and NSW South Western Slopes bioregions ▶ Semi-evergreen vine thicket in the Brigalow Belt South and Nandewar bioregions. 	High	<ul style="list-style-type: none"> ▶ Conservation significant: protected by BC Act ▶ Relatively intact: TEC generally comprised of relatively good condition vegetation ▶ Unique to the environment: TECs are unique to the region ▶ Poorly represented in the region: the extent TECs in the region have been significantly reduced from their former extent ▶ Proposal activities would have an adverse impact on TECs: vegetation clearing within TECs would remove TECs. 	BAM

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ NSW natural environment and native flora and fauna ▶ Biodiversity 	PCTs in High and Medium condition: <ul style="list-style-type: none"> ▶ 27 ▶ 35 ▶ 36 ▶ 52 ▶ 53 ▶ 55 ▶ 56 ▶ 98 ▶ 147 ▶ 192 ▶ 244 ▶ 247 ▶ 418 ▶ 628 	Moderate	<ul style="list-style-type: none"> ▶ The ecological receptor is in a moderate-to-good condition despite it being exposed to threatening processes. 	BAM
	PCTs in Low condition: <ul style="list-style-type: none"> ▶ 35 ▶ 36 ▶ 56 ▶ 192 ▶ 244 ▶ 247 ▶ 418 ▶ 628 	Low	<ul style="list-style-type: none"> ▶ The ecological receptor is in a poor-to-moderate condition as a result of threatening processes, which have degraded its intrinsic value. 	BAM

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ Native flora and fauna ▶ Biodiversity 	<p>Threatened terrestrial flora and fauna species listed under the provisions of the EPBC Act (some species also BC Act listed):</p> <p>Flora:</p> <ul style="list-style-type: none"> ▶ Bluegrass (<i>Dichanthium setosum</i>) ▶ Belson's panic (<i>Homopholis belsonii</i>) ▶ Winged peppercress (<i>Lepidium monoplacoides</i>) ▶ Slender darling pea (<i>Swainsona murrayana</i>) ▶ Slender tylophora (<i>Tylophora linearis</i>) <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> ▶ Australasian bittern (<i>Botaurus poiciloptilus</i>) ▶ Australian painted snipe (<i>Rostratula australis</i>) ▶ Border thick-tailed gecko (<i>Uvidicolus sphyrurus</i>) ▶ Curlew sandpiper (<i>Calidris ferruginea</i>) ▶ Dunmall's snake (<i>Furina dunmalli</i>) ▶ Grey-headed flying-fox (<i>Pteropus poliocephalus</i>) ▶ Koala (<i>Phascolarctos cinereus</i>) ▶ Large-eared pied bat (<i>Chalinolobus dwyeri</i>) ▶ Five-clawed worm-skink (<i>Anomalopus mackayi</i>) ▶ Painted honeyeater (<i>Grantiella picta</i>) ▶ Red goshawk (<i>Erythrotriorchis radiatus</i>) ▶ Corben's long-eared bat (<i>Nyctophilus corbeni</i>) ▶ Superb parrot (<i>Polytelis swainsonii</i>) ▶ Spot-tailed quoll (<i>Dasyurus maculatus maculatus</i>) ▶ Swift parrot (<i>Lathamus discolor</i>) ▶ White-throated needletail (<i>Hirundapus caudacutus</i>) <p>Aquatic fauna:</p> <ul style="list-style-type: none"> ▶ Murray cod (<i>Maccullochella peelii</i>) 	High	<ul style="list-style-type: none"> ▶ Protected by EPBC Act (some species also BC Act) ▶ Rare ▶ High sensitivity, high vulnerability. 	BAM/SIAM

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ Native flora and fauna ▶ Biodiversity 	<p>Migratory species listed under the provisions of the EPBC Act:</p> <ul style="list-style-type: none"> ▶ Common greenshank (<i>Tringa nebularia</i>) ▶ Common sandpiper (<i>Actitis hypoleucos</i>) ▶ Fork-tailed swift (<i>Apus pacificus</i>) ▶ Glossy ibis (<i>Plegadis falcinellus</i>) ▶ Latham's snipe (<i>Gallinago hardwickii</i>) ▶ Pectoral sandpiper (<i>Calidris melanotos</i>) ▶ Satin flycatcher (<i>Myiagra cyanoleuca</i>) ▶ Sharp-tailed sandpiper (<i>Calidris acuminata</i>) ▶ Yellow wagtail (<i>Motacilla flava</i>) ▶ Eastern osprey (<i>Pandion haliaetus</i>) 	High	<ul style="list-style-type: none"> ▶ Protected by EPBC Act (N.B. not a controlling provision of the Project under EPBC Act) ▶ High sensitivity, high vulnerability. 	SIAM
	<p>Threatened terrestrial flora and fauna species listed under the provisions of the BC Act:</p> <p>Flora:</p> <ul style="list-style-type: none"> ▶ <i>Cyperus conicus</i> ▶ Creeping tick-trefoil (<i>Desmodium campylocaulon</i>) ▶ Finger panic grass (<i>Digitaria porrecta</i>) ▶ Pine donkey orchid (<i>Diuris tricolor</i>) ▶ <i>Phyllanthus maderaspatensis</i> ▶ Braid fern (<i>Platyzoma microphyllum</i>) ▶ Native milkwort (<i>Polygala linariifolia</i>) ▶ Scant pomaderris (<i>Pomaderris queenslandica</i>) ▶ Silky swainson-pea (<i>Swainsona sericea</i>) <p>Terrestrial fauna:</p> <ul style="list-style-type: none"> ▶ Australian bustard (<i>Ardeotis australis</i>) ▶ Barking owl (<i>Ninox connivens</i>) ▶ Black-breasted buzzard (<i>Hamirostra melanosternon</i>) ▶ Black-chinned honeyeater (<i>Melithreptus gularis gularis</i>) 	High	<ul style="list-style-type: none"> ▶ Protected by BC Act ▶ Rare ▶ High sensitivity, high vulnerability. 	BAM

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ Native flora and fauna ▶ Biodiversity 	<ul style="list-style-type: none"> ▶ Black-necked stork (<i>Ephippiorhynchus asiaticus</i>) ▶ Blue-billed duck (<i>Oxyura australis</i>) ▶ Bristle-faced free-tailed bat (<i>Setirostris eleryi</i>) ▶ Brolga (<i>Grus rubicunda</i>) ▶ Black-striped wallaby (<i>Macropus dorsalis</i>) ▶ Black-tailed godwit (<i>Limosa limosa</i>) ▶ Brown treecreeper (eastern subspecies) (<i>Climacteris picumnus victoriae</i>) ▶ Bush stone-curlew (<i>Burhinus grallarius</i>) ▶ Cotton pygmy-goose (<i>Nettapus coromandelianus</i>) ▶ Diamond firetail (<i>Stagonopleura guttata</i>) ▶ Dusky woodswallow (<i>Artamus cyanopterus cyanopterus</i>) ▶ Eastern bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>) ▶ Eastern cave bat (<i>Vespadelus troughtoni</i>) ▶ Eastern grass owl (<i>Tyto longimembris</i>) ▶ Eastern pygmy-possum (<i>Cercartetus nanus</i>) ▶ Flame robin (<i>Petroica phoenicea</i>) ▶ Freckled duck (<i>Stictonetta naevosa</i>) ▶ Flock bronzewing (<i>Phaps histrionica</i>) ▶ Glossy black-cockatoo (<i>Calyptorhynchus lathamii</i>) ▶ Grey-crowned babbler (eastern subspecies) (<i>Pomatostomus temporalis temporalis</i>) ▶ Grey falcon (<i>Falco hypoleucos</i>) ▶ Hooded robin (southeastern form) (<i>Melanodryas cucullata cucullata</i>) ▶ Kultarr (<i>Antechinomys laniger</i>) ▶ Little eagle (<i>Hieraaetus morphnoides</i>) ▶ Little lorikeet (<i>Glossopsitta pusilla</i>) 	High	<ul style="list-style-type: none"> ▶ Protected by BC Act ▶ Rare ▶ High sensitivity, high vulnerability. 	BAM

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ Native flora and fauna ▶ Biodiversity 	<ul style="list-style-type: none"> ▶ Little pied bat (<i>Chalinolobus picatus</i>) ▶ Magpie goose (<i>Anseranas semipalmata</i>) ▶ Major Mitchell's cockatoo (<i>Lophochroa leadbeateri</i>) ▶ Masked owl (<i>Tyto novaehollandiae</i>) ▶ Northern free-tailed bat (<i>Mormopterus lumsdenae</i>) ▶ Pale imperial hairstreak (<i>Jalmenus eubulus</i>) ▶ Pale-headed snake (<i>Hoplocephalus bitorquatus</i>) ▶ Pied honeyeater (<i>Certhionyx variegatus</i>) ▶ Red-tailed black-cockatoo (inland subspecies) (<i>Calyptorhynchus banksii samueli</i>) ▶ Rufous bettong (<i>Aepyprymnus rufescens</i>) ▶ Scarlet robin (<i>Petroica boodang</i>) ▶ Speckled warbler (<i>Chthonicola sagittata</i>) ▶ Spotted harrier (<i>Circus assimilis</i>) ▶ Square-tailed kite (<i>Lophoictinia isura</i>) ▶ Squirrel glider (<i>Petaurus norfolcensis</i>) ▶ Stripe-faced dunnart (<i>Sminthopsis macroura</i>) ▶ Turquoise parrot (<i>Neophema pulchella</i>) ▶ Varied sittella (<i>Daphoenositta chrysoptera</i>) ▶ White-bellied sea eagle (<i>Haliaeetus leucogaster</i>) ▶ White-fronted chat (<i>Epthianura albifrons</i>) ▶ Woma (<i>Aspidites ramsayi</i>) ▶ Yellow-bellied sheath-tail-bat (<i>Saccolaimus flaviventris</i>) ▶ Zigzag velvet gecko (<i>Amalosia rhombifer</i>) 	High	<ul style="list-style-type: none"> ▶ Protected by BC Act ▶ Rare ▶ High sensitivity, high vulnerability. 	BAM

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ Native flora and fauna ▶ Biodiversity 	<p>Threatened aquatic fauna species, populations and communities listed under the provisions of the FM Act:</p> <p>Aquatic fauna:</p> <ul style="list-style-type: none"> ▶ Darling River snail (<i>Notopala sublineata</i>) ▶ Eel-tailed catfish (Murray–Darling population) (<i>Tandanus tandanus</i>) ▶ Southern purple spotted gudgeon (<i>Mogurnda adspersa</i>) ▶ Western olive perchlet (Western population) (<i>Ambassis adassizii</i>) ▶ Darling River EEC. 	High	<ul style="list-style-type: none"> ▶ Protected by FM Act ▶ Rare ▶ High sensitivity, high vulnerability. 	FM Act /SIAM
<ul style="list-style-type: none"> ▶ Land conducive to the maintenance of existing landforms, ecological health, biodiversity, riverine and wetland areas ▶ Biodiversity. 	<p>Areas of geological significance:</p> <ul style="list-style-type: none"> ▶ Great Artesian Basin 	High	<ul style="list-style-type: none"> ▶ Recognised by the state ▶ Important for biodiversity ▶ High sensitivity, high exposure to impacts. 	BAM
	Area/s of connectivity joining different areas of habitat that intersect with the subject land and the areas of habitat that are connected	Moderate	<ul style="list-style-type: none"> ▶ The ecological receptor is in moderate condition as a result of threatening processes, which have degraded its intrinsic value ▶ May provide habitat for threatened species. 	BAM
	Patches of native woody and non-woody vegetation	Moderate	<ul style="list-style-type: none"> ▶ The ecological receptor is in moderate condition as a result of threatening processes, which have degraded its intrinsic value ▶ May provide habitat for threatened species. 	BAM
	Important and local wetlands	Moderate	<ul style="list-style-type: none"> ▶ The ecological receptor is in moderate condition as a result of threatening processes, which have degraded its intrinsic value ▶ May provide habitat for threatened species. 	BAM
	Waterways and riparian buffers	Moderate	<ul style="list-style-type: none"> ▶ The ecological receptor is in moderate condition as a result of threatening processes, which have degraded its intrinsic value ▶ May provide habitat for threatened species. 	BAM

Associated ecological value	Identified ecological receptors	Assigned sensitivity	Justification	Assessment pathway (refer Section 11.4.4)
<ul style="list-style-type: none"> ▶ Land conducive to the maintenance of existing land forms, ecological health, biodiversity, riverine and wetland areas 	Type 1 fish habitat: <ul style="list-style-type: none"> ▶ Mobbindry Creek ▶ Back Creek ▶ Whalan Creek ▶ Macintyre River 	Moderate	<ul style="list-style-type: none"> ▶ The ecological receptor is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements. ▶ May provide habitat for threatened species. 	SIAM
	Type 3 fish habitat: <ul style="list-style-type: none"> ▶ Unnamed tributary of Mobbindry Creek ▶ Forrest Creek 	Low	<ul style="list-style-type: none"> ▶ The ecological receptor is in a poor-to-moderate condition as a result of threatening processes, which have degraded its intrinsic value. 	SIAM
	<ul style="list-style-type: none"> ▶ Biodiversity 			

Table note:

Because of the aerial nature of white-throated needletail (*Hirundapus caudacutus*), impacts of the proposal on the species and its habitat are not considered to be significant. This species is not considered further in the SIAM assessment.

Further information related to the classification of ecological receptors sensitivity is provided within Appendix B: Biodiversity Technical Report and Appendix S: Aquatic Biodiversity Technical Report.

11.8 Potential impacts

11.8.1 Proposal activities

Infrastructure activities proposed as part of the proposal have been categorised into three phases: construction, commissioning and reinstatement, and operation. A description of proposal-related activities and the duration of their disturbance is provided in Table 11.11.

TABLE 11.11 DESCRIPTION OF PROPOSAL RELATED ACTIVITIES ASSOCIATED WITH CONSTRUCTION, COMMISSIONING AND REINSTATEMENT AND OPERATION PHASES

Phase	Infrastructure activity	Description of activities	Duration of disturbance
Construction	Site preparation	Vegetation clearing	Permanent
		Topsoil stripping	Medium term/ Permanent
		Construction of temporary site compounds, camps and access tracks	Medium term
		Construction of rail access roads	Permanent
		Installation of boreholes and construction water	Medium term
		Installation of offices, hardstands, etc.	Medium term
		Stockpiling	Medium term
		De-watering of borrow pits	Short term
	Utility diversions	Excavation	Permanent
		Trenching	Short term
		Modification, diversion and realignment of utilities and associated infrastructure	Short term/Medium term
	Drainage	Culvert installation	Permanent
	Structures	Construction of bridges over main waterways	Medium term
		Road/rail bridge construction	Medium term
	Civil works	Cutting construction	Medium term
		Embankment construction using cut-to-fill from rail alignment and borrow-to-fill from external borrow sources, where required	Medium term
		Construction of temporary haul roads	Medium term
		Drainage controls	Medium term
	Road works	Road realignment	Permanent
		Construction of permanent rail maintenance access roads	Permanent
	Rail logistics	Sleeper stockpiling	Medium term
		Rail stockpiling	Medium term

Phase	Infrastructure activity	Description of activities	Duration of disturbance
Construction	Rail construction	Drilling	Temporary
		Blasting	Temporary
		Ballast installation	Short term
		Sleeper placement	Short term
		Rail placement	Short term
		Installation train signals and communications infrastructure	Short term
		Demobilising site compounds	Short term
	Signals and communications installation	Removal of temporary fencing	Temporary
Commissioning and reinstatement	Demobilisation	Establish permanent fencing	Temporary
		Restoration of disturbed areas, including revegetation where required	Short term
	Spoil mounds	Conversion of haul roads and construction access roads into permanent roads	Medium term
	Fencing	Train services	Permanent
	Restoration	Minor maintenance works	Temporary
	Road works	Bridge and culvert inspections	Temporary
		Sleeper replacement	Temporary
		Rail welding	Temporary
		Rail grinding	Temporary
		Ballast dropping	Temporary
		Track tamping	Temporary
		Major periodic maintenance	Temporary
Operation	Train operations	Train movement along rail	Permanent
	Operational maintenance	Ongoing vehicle movement within rail corridor	Permanent

Table notes:

Duration of disturbance definitions: Temporary—days to months (e.g. 1 to 2 seasons; 3 to 6 months); Short term—up to 2 years (i.e. 6 to 24 months); Medium term—from 2 to 10 years; Long-term/long lasting—from 11 to 20 years; Permanent or irreversible—more than 21 years (refer Appendix B: Biodiversity Technical Report for full definitions).

11.8.2 Potential impacts to terrestrial and aquatic ecology

Potential impacts to biodiversity values associated with proposal activities have been summarised into 19 broad categories, including:

- ▶ Habitat loss and degradation from vegetation clearing/removal
- ▶ Fauna species injury or mortality
- ▶ Reduction in biological viability of soil to support growth due to soil compaction
- ▶ Displacement of flora and fauna species by invasion of weed and pest species
- ▶ Reduction in the connectivity of biodiversity corridors
- ▶ Edge effects
- ▶ Habitat fragmentation
- ▶ Barrier effects
- ▶ Noise, dust and light impacts
- ▶ Increase in litter (waste)
- ▶ Erosion and sedimentation
- ▶ Disturbance to specialists breeding and foraging habitat
- ▶ Trampling of threatened species
- ▶ Fallen timber and bush rock collection and removal
- ▶ Fertiliser drift
- ▶ Increased fire risk
- ▶ Aquatic habitat degradation.
- ▶ Floodplain hydrology
- ▶ Groundwater dependent ecosystems (GDEs).

A comprehensive description of these potential impacts is provided in Appendix B: Biodiversity Technical Report, and Appendix S: Aquatic Biodiversity Technical Report. A description of potential impacts identified above is provided in the following sections. Potential impacts to fauna species credit species that have been identified within the subject land are outlined in Section 11.8.3.

11.8.2.1 Habitat loss and degradation from vegetation clearing/removal

The removal of vegetation resulting in habitat loss and degradation is likely to pose the largest risk of adverse impacts for Biodiversity Technical Report arising from the proposal. The impact may be direct, in the form of vegetation and habitat removal. It may also be indirect, such as a reduction in flora and fauna diversity due to shortages in available habitat resources or habitat degradation in areas adjacent to direct impacts. Habitat loss as a result of vegetation clearing is likely to occur during the construction-phase activities. TECs and habitats for threatened species are included in the likely ecological receptors potentially impacted.

The ecological receptors that are most likely to be impacted include TECs and habitat-specialist fauna species **which are dependent on native vegetation, such as Dunmall's snake, koala, large-eared pied bat, five-clawed worm-skink and spot-tailed quoll**. The potential effects associated with this impact include direct loss of breeding habitat and loss of foraging habitat, which will in turn lead to greater pressure on remaining available habitat outside of the subject land. The resulting increase in pressure on resource availability is likely to increase individual animal stress levels, which may result in reduced breeding success, genetic isolation and population decline over time.

11.8.2.2 Fauna species injury or mortality

Fauna injury and/or death is a direct impact that reduces local population numbers and is most likely to occur during vegetation removal associated with the proposal activities. This trauma has the potential to occur during all phases of the proposal, particularly through construction activities that involve vegetation clearing, earthworks, trenching and increased labour force in the fields (through the movement of vehicles). This potential impact will be proportionate to the extent of vegetation and habitat potential for species that is removed and has the potential to impact ecological receptors, including habitat for threatened fauna species listed under the provisions of the EPBC Act and/or BC Act. During the operational phase, there is some potential for mortality, due to train strike, and may include the squirrel glider during glides.

11.8.2.3 Reduction in biological viability of soil to support plant growth due to soil compaction

Compaction of soil as a result of the proposal activities may result in direct impacts to soil consistency (i.e. the strength and coherence of a soil) and soil structure (i.e. the arrangement of soil particles). The most direct effect of soil compaction is an increase in the bulk density of soil, which can restrict plant root growth and function. The unmitigated potential impacts of soil compaction resulting from the proposal are generally short term and temporary.

The most direct effect of soil compaction is an increase in the bulk density of soil, which can restrict plant root growth and function. Because of the increase in bulk density, large pores essential for water and air movement in soil are primarily affected. This influence over water and air movement can impact root penetration, seedling emergence and plant growth (Fitzpatrick et al., 1999; Duiker, 2004). Threatened flora species most likely to be affected by this impact include *Desmodium campylocaulon*, *Homopholis belsonii*, *Dichanthium setosum* and *Swainsona murrayana*. This impact may also affect TECs in the long term, with a reduction in recruitment leading to a gradual decline in condition.

11.8.2.4 Displacement of flora and fauna species from invasion of weed and pest species

Weed and pest species have the potential to impact on Biodiversity Technical Report as native species can become displaced through predation and competition with exotic biota. Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of the proposal activities) that may have cumulative effects. This is because each proposal activity, as well as agricultural practices and other resource proposal activities, may act in conjunction to increase the chances of weed and pest proliferation throughout the proposal area and adjoining areas.

Unmitigated proposal activities have the potential to disperse pest (animal) species from the subject land into the surrounding landscape due to habitat removal, noise disturbance and human presence during the construction and operation phases of the proposal. Therefore, unmitigated potential impacts of the displacement of native species through the invasion of non-native species may be temporary or permanent.

TECs in the subject land that are most likely to be affected include poplar box grassy woodlands on alluvial plains, natural grasslands on basalt and fine-textured alluvial plains and semi-evergreen vine thickets. PCTs, habitat for threatened species, wetlands and waterways may also be affected.

11.8.2.5 Reduction in the connectivity of biodiversity corridors

Biodiversity corridors can be defined as systems of linear habitat that enhance the connectivity of wildlife populations and may help to overcome the main consequences of habitat fragmentation (Wilson and Lindenmayer, 1995). Corridors can assist ecological functioning, at a variety of spatial and temporal scales, from daily foraging movements of individuals to broad-scale genetic gradients across biogeographical regions. Some connectivity, especially around waterways and some roadsides, is present throughout much of the subject land. Several borrow pits exist as isolated islands surrounded by agricultural activity. These islands may act as 'stepping stones' for species movement across the landscape.

The potential impacts of linear infrastructure traversing these biodiversity corridors include habitat fragmentation, edge effects and barrier effects. The unmitigated potential impacts to biodiversity corridors resulting from the proposal may potentially be long term and irreversible. Threatened fauna species most likely to use biodiversity corridors in the study area include spot-tailed quoll, squirrel glider, red goshawk and Australasian bittern.

11.8.2.6 Edge effects

Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats. These new environmental conditions along the habitat edges can promote the growth of different vegetation types (including weed species), promote invasion by pest animals specialising in edge habitats, or change the behaviour of resident native animals (Moenting and Morris, 2006).

Edge effects have the potential to adversely impact threatened flora and fauna species identified as potentially occurring in the subject land, especially on the species with specific micro-habitat requirements that are less **tolerant to disturbance** (i.e. **Dunmall's snake**, speckled warbler, brown tree creeper and Australian painted snipe). Birds are particularly sensitive to disturbance during breeding, and may abandon nests.

Conversely, some threatened plant species appear to respond positively to edge effects, particularly ground disturbance, and are able to colonise these edge areas reasonably quickly (e.g. *Dichanthium setosum*).

The unmitigated potential impacts of edge effects resulting from the proposal are considered to be both short-term in some instances and irreversible in others.

11.8.2.7 Habitat fragmentation

Habitat fragmentation relates to the physical dividing up of a continuous habitat into separate smaller fragments (Fahrig, 2002). The habitat fragments tend to be smaller and separated from each other by a matrix of less suitable habitat.

Woodlands specialist species with limited dispersal capabilities are most likely to be affected by habitat fragmentation. Ecological receptors with limited dispersal capability in fragmented landscapes include brown tree creeper, five-clawed worm-skink, squirrel glider and eastern pygmy-possum.

The fragmentation of habitat resulting from the proposal is most likely to occur where the proposal intersects existing areas of native vegetation, such as along the Macintyre River. The unmitigated potential impacts of habitat fragmentation resulting from the proposal may potentially be long-term and irreversible.

11.8.2.8 Barrier effects

Barrier effects occur where particular species are either unable or unwilling to move between suitable areas of habitat due to the imposition of a barrier. This can include a habitat type that has become unsuitable or a physical barrier such as a fence.

Various proposal activities may create barrier effects, particularly those that may create a hard barrier that restricts fauna movement (e.g. access tracks, easements). This impact may affect small mammals, frogs, reptiles and threatened species such as Dunmall's snake, five-clawed worm-skink, kultarr, pale-headed snake, stripe-faced dunnart, squirrel glider and woma. Mobile species such as larger mammals, birds and bats may not be affected to the same extent.

Given that a large proportion of the proposed works will occur within the existing non-operational Boggabilla rail corridor, much of the most permanent barrier related to the proposal already exists, although the corridor will become wider. The widening of the rail corridor may increase the existing barrier effects for some species. The unmitigated potential impacts of barrier effects resulting from the proposal are considered to be in most cases short-term and temporary but may in some cases be long-term and irreversible where new infrastructure is developed.

11.8.2.9 Noise, dust and light impacts

Noise, dust and light are direct impacts that have the potential to occur as a result from the proposal activities during all phases and may also have cumulative effects. The likelihood of potential impacts is anticipated to be greatest where the proposal activities take place near vegetated areas and known habitat, during the construction and rehabilitation phases. Operating rail lines will generate noise and vibration and it is likely that many species will habituate as a result of the regularity of generated noise.

Ecological receptors affected by these potential impacts include all threatened flora and fauna species listed under the provisions of the EPBC Act and/or BC Act. Ecological receptors involving remnant vegetation and habitat may also be impacted to a lesser extent. These types of impacts are likely to be short in duration and localised.

11.8.2.10 Increase in litter (waste)

Littering has the potential to impact the surrounding environment by causing injury to wildlife, posing threats to human health and being aesthetically displeasing. This type of impact has the potential to be long in duration because of the varying times of decomposition; however, it is likely to be localised and manageable.

11.8.2.11 Erosion and sedimentation

Impacts associated with erosion and sedimentation include compaction of soil, loss of soil structure, nutrient degradation and increased soil salinity. This can lead to reductions in the carrying capacity of the terrestrial environment as a result of decreasing habitat value.

The transport of sediment and eroded material can be washed off areas of exposed soil, stockpile locations, or localised areas in proximity to proposal infrastructure (e.g. culverts and bridges) during rainfall. It may also result from activities that interfere directly with waterways (e.g. augmentation to channels, uncontrolled livestock access and removing riparian vegetation).

Erosion and subsequent sedimentation can be damaging to the ecological health of waterways and the surrounding terrestrial environment and may be a proximate cause of environmental degradation. Mobilised coarse sandy sediment and silt tends to accumulate in areas of slow-flow and may smother bottom-dwelling organisms and their habitats. Deep permanent river pools, valuable habitats for aquatic fauna, and refuges for wildlife during summer and drought, may become filled by coarse sediments. This may render them ineffective in their ability to support aquatic and terrestrial species.

Large sediment accumulations can cause upstream flooding or deflect the flow into the adjacent stream bank or even onto adjacent land, causing further erosion. Transported sediments could also fill the deep permanent pools of rivers and ruin this critical refuge habitat. Threatened species dependent on water sources within the subject land include Australasian bittern, Australian painted snipe, Diamond firetail, freckled duck, turquoise parrot and black-necked stork.

11.8.2.12 Disturbance to specialists breeding and foraging habitat

Many fauna species have specific requirements for breeding and foraging. Hollow nesting birds often have a limited range in the size of hollows that they will use for breeding purposes. Masked owls require a hollow that is at least 20 cm in diameter in tall trees. Glossy black cockatoos are specialist feeders on *Allocasuarina* and *Casuarina* species and require hollows of at least 15 cm in diameter which are at least 5 m above ground (DPIE, 2019a).

Works associated with the proposal will have both direct and indirect effect on specialist habitat. Direct impacts will include the removal of hollow-bearing trees and feed trees. Indirect impacts such as noise during project works and rail line operations may affect where these species choose to nest and feed. Species which may be impacted due to the disturbance of these habitat features include Masked owls, Barking owls, Glossy black cockatoos and Squirrel gliders. These impacts are likely to be long-term in relation to the removal of hollow-bearing trees and may be short- or long-term in relation to operational noise, depending on individual species resilience.

11.8.2.13 Trampling of threatened species

Trampling of threatened species has the potential to reduce an individual plant's resilience or kill it. This, in turn, can lead to a reduction in the number of individuals of a threatened species found within a location, thus further increasing its risk of extinction at a local or broader level.

Project works have the potential to impact on areas of native vegetation during the construction phase if workers choose to leave the work areas during breaks or to park in non-designated areas. To date no threatened flora species have been identified within the study area. Species which may be impacted by trampling include Native milkwort, listed native grasses and listed *Swainsona* species.

11.8.2.14 Fallen timber and bush rock collection or removal

The removal of fallen timber and bush rock causes a decrease in habitat for small reptiles, small mammals, arachnids and flora species. Fallen timber and bush rock create microclimates by increasing shade and reducing wind effects thus providing habitat for small fauna to hide from predators, hunt for food, shelter and escape from fires. Species which may be affected by the removal of fallen timber and bush-rock removal include the Border thick-tailed gecko.

Wood and bush-rock collection outside of those areas which will be directly impacted by the proposal is not considered to be an increased risk. Borrow pits 1 and 2 have the highest amount of surface bush rock areas to be removed as part of the development of those borrow pits, should that occur. Access to remnant vegetation areas is not likely to change as a result of the proposed works, therefore no additional removal of habitat material is considered likely. Species which may be impacted by the removal of fallen timber and bush rock include Spot-tailed quoll and Border thick-tailed gecko.

11.8.2.15 Fertiliser drift

Fertiliser drift has the potential to cause damage to native remnant vegetation by changing the growth rate of some species in relation to others. Often exotic species are more likely to benefit from the addition of fertiliser over that of native species. Fertiliser drift also has the potential to change the native species composition of ecological communities which in turn can affect the habitat suitability for threatened species.

Some listed native grasses may benefit from a small amount of fertiliser drift; however, other species such as *Swainsona* may be crowded-out grass species. An increase in grass density may also reduce the ability of forbs and tree species to germinate and/or grow above the grass height and reach maturity. Fertiliser drift is usually associated with highly intensive agricultural activities such as cotton farming or viticulture. However, a limited amount may already occur in areas where the existing native vegetation is located directly adjacent to areas of intensive agriculture. The removal of native vegetation as part of the Project works may lead to a new area of vegetation becoming exposed to fertiliser drift because of the removal of that vegetation buffer. However, the distance between any farming practices and remnant vegetation will remain consistent with current conditions as clearing will be associated with project works and do not include the use of fertiliser.

Plant communities which may be adversely affected by fertiliser drift include Weeping Myall and Brigalow, while growth rates and densities of individual listed species such Bluegrass, Finger panic grass, Belson's panic and *Swainsona* may also be affected.

11.8.2.16 Increased fire risk

An increase in fire frequency is likely to disrupt the lifecycle of flora and fauna and often results in a change in vegetation structure, which includes loss of fallen timber and stags and is often followed by an increase in shrub density. While many Australian flora species have developed mechanisms to cope with fire in the landscape, frequent fires will decrease the resilience of the plant communities. Some flora species may be burnt before they are mature enough to seed, thus reducing the diversity of the vegetation community, which, in turn, can further reduce its habitat quality. Excessively hot fires also have the potential to sterilise the ground by killing the seedbank and further altering the vegetation structure.

The loss of fallen timber and stags decreases habitat availability for many native species and is likely to increase stress and resource pressure on fauna species. The loss of these habitat features may also increase the risk of predation of species by both native and introduced fauna.

The proposal may increase the risk of fire due to hot works during construction activities and the chance of sparks occurring off the train wheels during times of hot and dry conditions. Species which may be impacted upon by an increased fire frequency include hollow dependant species such as barking and masked owls, squirrel gliders and large cockatoo species. Flora which may be impacted by increased fire frequency include scant pomaderris, native milkwort and *Tylophora linearis*.

11.8.2.17 Aquatic degradation

The following impacts may potentially occur to the aquatic environment as a result of the proposal:

- ▶ Fauna mortality as a result of construction activities (e.g. draining of water bodies, construction activity directly occurring in waterbodies, adverse impacts to water quality)
- ▶ Creation or exacerbation of barriers to fish and other aquatic fauna movement (e.g. physical barriers such as rock beds, hydraulic barriers such as areas of high velocity flows where channels are created, chemical barriers such as pollution plumes, noise and vibration, or behavioural barriers such as dark tunnels created by culverts)—creates a barrier to aquatic fauna movement and potentially disrupts lifecycle events
- ▶ Further fragmentation of aquatic habitat as a result of the instalment of road-based infrastructure—creates a barrier to aquatic fauna movement, potentially disrupts lifecycle events, reduction in genetic diversity
- ▶ Introduction of non-native aquatic species and pathogens such as the introduction of noxious fish, aquatic weeds and diseases—competition and habitat disruption may lead to local population decline for some aquatic fauna.

Floodplain hydrology

The proposal alignment crosses the Macintyre River floodplain traversing both the Macintyre River channel and several tributaries including Whalan Creek, Forest Creek, Back Creek and Mobbindry Creek. The proposal includes the construction of an embankment that will be approximately 2 m in height above the surrounding landscape. In some areas, such as the approaches to the Macintyre River, this will increase to 7.5 m above the surrounds. Therefore, the proposal has the potential to impact aquatic (and terrestrial) ecosystems through a range of processes associated with changes to local flood patterns, such as flow velocities, flood duration and pathways and changes in flood height. Nevertheless, it should be noted the rail alignment is for the most part located adjacent to an existing rail embankment (non-operational) standing approximately 1.5 m above the surrounding lands, which already impacts localised flooding to some extent.

Detailed hydrologic and hydraulic assessments have been undertaken due to the catchment size and substantial floodplain flows associated with this extensive floodplain area. A hydraulic sub-model was developed covering the floodplain area down to Goondiwindi. The reliability of the hydrologic and hydraulic models was confirmed with correlation of data from three flood events as supplied by DPIE. Based on this performance, the hydrologic and hydraulic models were considered suitable to use to assess the potential impacts associated with the rail alignment.

Design event hydrology was developed from the calibrated hydrologic models using *Australian Rainfall and Runoff 2016* (OEH, 2019) flood flow estimation methods. The hydraulic sub-model was run for a suite of design events from the 20% annual exceedance probability (AEP) event to the peak mean flood level. The flows and levels predicted by the hydrologic and hydraulic models were compared to the results of a flood frequency analysis at the Boggabilla stream gauge, as well as results from previous flood studies and were found to be consistent. The design validation of the 1% AEP event indicated that the hydrologic and hydraulic models were adequately representing the 1% AEP event.

Modelling of the current state of development (Existing Case) was undertaken and details of the existing flood regime were determined for the modelled design events. The proposed works associated with the proposal (including rail embankments and drainage structures) were incorporated into the hydraulic model (Developed Case) and assessment of the potential impacts on the existing flood regime was undertaken.

Changes in peak water levels, velocities, flow patterns and flood inundation extents and durations have been identified and mapped. The results of the modelling are presented in detail in Chapter 14: Surface Water and Hydrology and are summarised as follows:

- ▶ Changes in peak water levels—changes in peak water levels for the majority of the alignment were predicted to increase up to 200 mm immediately upstream of the rail line, decreasing to less than 10 mm within 1,500 m of the alignment. Two isolated sections were predicted to increase to 320 mm and 230 mm, respectively, upstream of the rail line although the area of impact for both areas was restricted to 0.04 km² or less. For events smaller than the 1% AEP event, the changes in peak water levels reduce as the magnitude of the flood reduces and the flow is mostly contained to the creek and river channels.
- ▶ Change in duration of inundation—the time of submergence (ToS) for the Existing Case and the change in duration of flood inundation due to the proposal, was modelled for several road inspection locations. The results showed the increase in duration of inundation was limited with only one location (on the Bruxner Highway), where an increase of up to one hour is predicted under the 1% AEP event. Given the long duration of flooding on the Macintyre River floodplain, this change can be considered negligible. Average annual time of submergence (AAToS) is a measurement of the estimated time per year of submergence of a roadway, due to flooding. This was determined for several roads associated with the proposal footprint, with results showing a change of less than one hour for most locations.
- ▶ Flood flow distribution—the Macintyre River floodplain is complex, with many braided flowpaths and channels. To assess potential changes to the flow distribution because of the proposal, flows were extracted from the hydraulic sub-model at a number of locations across the floodplain. The modelling results showed there were minimal changes for the 1 per cent AEP flood event between the Existing and Developed Cases.
During the development of the proposal design, concerns were raised regarding the impact of the alignment embankment on the southern side of Whalan Creek. The concerns related to the embankment potentially preventing the spread of flow from Whalan Creek in a south-westerly direction as flood events rise and, instead, additional flow being retained in Whalan Creek or redirected north-west toward Boggabilla and Goondiwindi. Comparison of the Existing Case and Developed Case over time showed the proposal design (including bridge openings at appropriate locations) maintained current flood flow distribution and confirmed redirection of flood waters toward Boggabilla and Goondiwindi will not occur.
- ▶ Flood velocities—in general, changes to peak flood velocities (for the 1 per cent AEP flood event) are minor, with most changes in velocities experienced immediately adjacent to the proposal alignment. The flood modelling showed the proposal design results in minimal changes to peak water levels, velocities and flood flow distribution across the floodplain and in each of the waterways. This means the proposal design minimises potential changes to the geomorphological conditions in the waterways and, as such, the risk of change to geomorphological conditions in each of the waterways is low.

Flood-impact objectives have been established and used to guide the proposal design, including mitigation of impacts through refinement of the hydraulic design. This includes adjustment of the numbers, dimensions and location of major drainage structures. The design of these structures will continue to be refined as the proposal moves into the final design phase, including further consideration of associated ecological receptors. As such, the potential impacts to aquatic ecology receptors (and terrestrial habitat ecological receptors) as a result of changes to local hydrology are considered minor, localised and restricted to transient events.

Further information related to floodplain hydrology is provided within Chapter 13: Surface Water and Hydrology.

Groundwater dependent ecosystems

High-potential aquatic groundwater dependent ecosystems (GDEs) were identified over 1 km from the proposed alignment at Malgarai Lagoon and in an upstream portion of the Macintyre River. High-potential terrestrial GDEs were identified in several of the ephemeral waterbodies crossed by the proposal. Proposal activities are not anticipated to affect shallow groundwater near these high-priority GDEs given their distance from the alignment and/or the fact that construction works are not anticipated to intersect groundwater.

Only a limited impact on groundwater levels is expected (refer Chapter 14: Groundwater). As such, there are unlikely to be any adverse impacts on the identified high-potential terrestrial GDEs and these are not addressed further within this report.

11.8.3 Potential impact to fauna species credit species which have been identified within the subject land

11.8.3.1 Squirrel glider

The Squirrel glider is a small, nocturnal, tree dependent gliding marsupial that feed on nectar, pollen, plant exudates (*acacia* gum and *eucalyptus* spp), invertebrates and honeydew. This species live in social groups of two to nine individuals in leaf-lined nests in tree hollows, generally within a 5–15 ha home range (Goldingay, Sharpe, & Dobson, 2010). Home range varies according to habitat quality, especially presence of feed trees and habitat trees with suitable hollows. This species has a strong affinity with their home range and even if clearing claims most of the home range, they typically do not move to nearby vegetation (Wildlife Preservation Society Queensland, 2019).

Squirrel glider occurrence is highly localised and dependent on availability of suitable foraging habitat with tree hollows. Colonies require multiple den trees within their home ranges. High population density is only achievable in habitats with abundant hollow-bearing trees (>4 habitat trees/ha) and abundant food trees (Sharpe & Goldingay, 2010). Dead trees (stags) are an important habitat component and are used when available. A high abundance of tree hollows (including stags) and food trees were observed in multiple sites throughout the subject land, particularly within the riparian corridors of the Macintyre River and the major creeks.

Tree hollows used can have entrance sizes of 2.5 to 12 cm diameter, although hollows with entrances \leq 5 cm wide are used most frequently. Gliders select small entrances (about 3 to 5 cm entrance diameter) to exclude competitors and predators. Most foraging is within about 400 m of dens.

The main threats are loss and degradation of habitat, habitat fragmentation and resulting population fragmentation, loss of tree hollows, roadkill, frequent fire, predation, collision with barbed wire fencing, weed invasion and removal of dead wood and dead trees (OEH, 2018). Habitat loss and degradation has the potential to reduce the local abundance of the species, particularly when hollow-bearing trees are removed. The loss of suitable hollow-bearing trees may make habitat unsuitable. Habitat fragmentation and resulting population fragmentation has the potential to reduce the genetic diversity of the local population and therefore reduce species' resilience. Direct mortality resulting from train strike may reduce the local abundance of the species.

11.8.3.2 Koala

This species was identified within the riparian vegetation of the Macintyre River (PCT 36).

The koala is a medium-sized arboreal marsupial with a highly specialised diet of eucalypt leaves. The distribution of the koala ranges from northeast Queensland to southeast South Australia, including most of NSW except the far north west. The koala is sexually dimorphic, with males generally larger than females. Individuals in the north of the species range are typically smaller than individuals in the south. The average weight of males is 6.5 kg in Queensland and 12 kg in Victoria. Female koalas typically produce a single offspring annually, during October to May (Martin and Handasyde, 1999). Joeys remain in the pouch for six to eight weeks, when they move to their mother's back and remain dependent until 12 months of age.

Foraging occurs during dawn, dusk and night, and is restricted to the foliage of trees from the *Eucalyptus*, *Angophora*, *Lophostemon* and *Corymbia* genera. Specific food trees differ between regions, with koala habitat at most sites supporting one or a few suitable food tree species. Suitable habitat for the species includes temperate, sub-tropical and tropical forest, woodlands and semi-arid vegetation communities dominated by *Eucalyptus* spp. (Martin and Handasyde, 1999). Shelter trees from a range of genera are an important component of koala habitat and play an essential role in thermoregulation (Crowther et al., 2013). The koala is not territorial but forages within home ranges that overlap with the home ranges of other individuals. Males usually have a larger home range than females. Home ranges vary in size from less than 10 ha to over 100 ha, depending on habitat quality.

The main threats to the koala are habitat loss and fragmentation, vehicle strike, predation by dogs, disease, climate change, and drought. Historical land clearing in eastern Australia has significantly reduced the extent of habitat available for the Koala. Remaining habitat is often fragmented and ultimately unviable due to isolation. Local declines and extinctions in isolated Koala sub-populations may be attributed to *Chlamydia* infection, which reduces female fertility (Department of Environment and Climate Change (DECC), 2008).

11.9 Impact mitigation

11.9.1 Alternative options

Following the hierarchical approach to environmental management, options to avoid and minimise impacts have been considered and altered throughout the early development phase. These options include use of the existing rail corridor, wherever feasible, the location of temporary infrastructure within non-native vegetation or disturbed vegetation where possible, and the siting of bridges.

Where possible the proposal footprint was restricted to avoid areas of MNES, BC Act-listed ecological receptors and their associated habitat, as far as practical, to that required to safely and efficiently construct and operate the proposal, thereby minimising significant adverse residual impacts to these areas.

Details of alternative options are provided in Chapter 3: Alternatives and Proposal Options.

11.9.2 Mitigation measures

ARTC has committed to applying impact mitigation measures to minimise proposal-related impacts on environmental attributes. These mitigation measures are presented in Table 11.12.

TABLE 11.12 PROPOSAL IMPACT MITIGATION MEASURES

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Flora and fauna/ biodiversity	<ul style="list-style-type: none"> ▶ Undertake detailed design and/or construction planning to minimise the construction footprint and avoid impacts to vegetation as far as practicable. Clearing of vegetation will be limited as far as practicable and disturbance is to only occur within the approved footprint. ▶ A Biodiversity Management Sub-plan will be developed as part of the CEMP. This plan should include appropriate criteria, directives and procedures in relation to: <ul style="list-style-type: none"> ▶ Methods and sequencing of threatened plant surveys, in accordance with the requirements of <i>NSW Guide to Surveying Threatened Plants</i> (OEH, 2016b) ▶ Methods and sequencing of pre-clearance fauna surveys, including terrestrial, aquatic and breeding habitats (including burrows and hollow bearing trees/logs, existing culverts and structures). ▶ Staging works to avoid animal breeding periods where possible. ▶ Develop a Soil Management Sub-plan that includes procedures and protocols relevant to potential impacts to the receiving environment: <ul style="list-style-type: none"> ▶ Soil/land conservation objectives for the proposal ▶ Management of problem soils (refer Chapter 15: Land Resources and Contamination), such as: <ul style="list-style-type: none"> - Cracking clays (vertosols) that are expected to be encountered directly south of the Macintyre River - Saline soils, particularly in potential expression areas, such as soil salt stores, artificial restrictions and roads. ▶ Specification of the type and location of erosion and sediment controls. The erosion and sediment control measures, developed in accordance with the <i>Managing Urban Stormwater</i> series (Bluebook) to be implemented during construction of the proposal include: <ul style="list-style-type: none"> - Minimise disturbance of areas identified as susceptible to erosion - Where possible, use existing tracks. Design new access tracks (permanent and temporary) with the aim of minimising disturbance of substrates and vegetation - Water quality and erosion control measures that consider site-specific soil types - Prescribed erosion and sediment controls relevant to the site risk.
	Riparian vegetation and aquatic habitats	<ul style="list-style-type: none"> ▶ The design will continue to be developed to minimise the extent of impacts to waterways, riparian vegetation and in-stream flora and habitats, in accordance with relevant policies and guidelines, including: <ul style="list-style-type: none"> ▶ <i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i> (DPI, 2013) ▶ <i>Guidelines for controlled activities on waterfront land</i> (DPI, 2012).

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Water quality	<ul style="list-style-type: none"> ▶ A Surface Water Management Sub-plan will be developed as a component of the CEMP. The sub-plan will provide a surface water monitoring framework for the proposal that establishes: <ul style="list-style-type: none"> ▶ Frequency, testing requirements and location of surface water sampling during construction of the proposal, with consideration for: <ul style="list-style-type: none"> - Construction activities with potential to impact water quality - Seasonality - Sensitivity of receiving watercourse. ▶ A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of instances (including accidental discharge of contaminants and sediments) that trigger contingency and ameliorative measures ▶ Responses to impact threshold exceedances.
	Fauna passage	<ul style="list-style-type: none"> ▶ Fauna movement opportunities identified during the reference design process will be developed and refined during detailed design. Development of these opportunities will involve: <ul style="list-style-type: none"> ▶ Assessment of the compatibility of each approach with the general design principles at each location ▶ Assessment of adjacent habitat and connectivity (including existing adjacent land use) ▶ Consideration of safety requirements for the rail corridor and adjoining properties ▶ Elevated fauna crossing structures may be required to provide clearance over double-stacked trains (e.g. glider poles). To be determined at detailed design, taking into account safety requirements (e.g. for higher bridges or viaducts, rope-bridges may be more practical) ▶ Fauna crossing structures that may be suitable include glider poles, rope-bridge underpasses and fauna furniture within culverts ▶ Fauna exclusion fencing will be used to channel fauna towards crossing structures.
	Fauna fencing	<ul style="list-style-type: none"> ▶ Fauna fencing opportunities will be further developed during detailed design. Development of these opportunities will involve: <ul style="list-style-type: none"> ▶ Assessment of the compatibility of each approach with the general fencing principles at each location and existing land use ▶ Consideration of safety requirements for the rail corridor and adjoining properties. For example, rail corridor fencing has not been proposed across the Macintyre River floodplain, to prevent the possibility of debris accumulation in fencing during flood events ▶ Consideration for maintenance constraints that a fauna connectivity or fencing opportunity may introduce. ▶ Priority will be given to fauna fencing in areas identified as state, regional or local fauna movement corridors to channel fauna toward safe movement options (i.e. culverts) to limit vehicle strikes and associated incidents.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Aquatic fauna	<ul style="list-style-type: none"> ▶ The design will continue to be developed to minimise the extent of impacts to waterways, riparian vegetation and in-stream flora and habitats, in accordance with the current applicable policies/legislation ▶ The detailed design will be developed to minimise the potential for watercourse diversion, as defined under the FM Act 1994 ▶ Detailed design and construction will be undertaken to ensure fish passage is maintained. Any watercourse crossing structures will be designed in accordance with <i>Why do fish need to cross the road? Fish passage requirements for waterway crossings</i> (DPI, 2013).
	Flora	<ul style="list-style-type: none"> ▶ Construction areas including compounds, stockpiles, fuel storage areas, laydown areas and staff parking will be located and established outside the tree protection zone as defined in <i>AS4970-2009 Protection of trees on development sites</i>.
	Weeds and pests	<ul style="list-style-type: none"> ▶ A Biosecurity Management Sub-plan will be developed as a component of the CEMP in accordance with the <i>Biosecurity Act 2015</i> (Cth) ▶ Property-specific biosecurity requirements will be agreed with the relevant landowner/operator prior to pre-construction/construction activities occurring on that property. Agreed protocols will be documented in individual property management agreements, to be signed by ARTC and the landowner/operator.
	Rehabilitation	<ul style="list-style-type: none"> ▶ A Rehabilitation and Landscaping Management Sub-plan will be developed for the proposal, as a component of the CEMP. This sub-plan will be based on the <i>Inland Rail Landscape and Rehabilitation Strategy</i>, the <i>Inland Rail Landscape and Rehabilitation Framework</i> and property-specific reinstatement commitments. As a minimum it will establish: <ul style="list-style-type: none"> ▶ Location-specific objectives for rehabilitation of borrow pit sites, reinstatement and/or stabilisation. Objectives will differ for within the rail corridor and outside of the rail corridor. Outside of the rail corridor, property-specific and township-specific (e.g. North Star) rehabilitation and landscaping requirements may apply ▶ Timeframes for rehabilitation and/or reinstatement/stabilisation works to be achieved ▶ Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the agreed objectives ▶ Include rehabilitation requirements such as: <ul style="list-style-type: none"> - Milling and removal of bitumen pavement - Removal of any decommissioned culverts - Tying and ripping of base and sub-base material - Application of soil ameliorants - Topsoiling and/or compost blanket - Stabilisation and rehabilitation (e.g. planting and or seeding).

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Rehabilitation	<ul style="list-style-type: none"> ▶ Consideration for maintenance or performance issues of rehabilitation, e.g. vegetation that does not grow and obscure signals or impact the longevity of rail infrastructure ▶ Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas ▶ Where temporary construction facilities/borrow pits are required, land shall be returned to a stable condition that complies with the conditions of applicable landowner agreements and regulatory approvals.
	Offsets	<ul style="list-style-type: none"> ▶ Biodiversity offsets will be developed in consultation with the Department of Agriculture, Water and the Environment (DAWE) (Australian Government) and the Department of Planning, Industry and Environment (NSW).
Pre-construction/ Construction	Flora and fauna/ biodiversity	<ul style="list-style-type: none"> ▶ Scheduling of construction activities to minimise time of works in or adjacent to drainage lines, waterways or watercourses, particularly during periods of flow ▶ Clearly mark designated 'no-go' areas and clearing extents/site boundary/limit of works prior to any vegetation clearing. ▶ Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species ▶ A qualified ecologist with relevant NSW licences will undertake pre-clearance surveys of remnant and regrowth vegetation ▶ The ecologist will supervise the subsequent clearing of where damage to any trees 3 m or greater in height; where arboreal fauna has been identified in or adjacent to the clearing front, known and potential habitat trees, log piles, burrows, stags and nests may occur, and areas identified as containing threatened fauna species, habitat and mapped PCT/TECs ▶ Scheduling of clearing activities will be done to avoid breeding seasons as far as reasonably practical. Where this is not practical, and where breeding sites are identified within the corridor during pre-clearance surveys, a suitably qualified person will provide mitigation measures for exclusion zones/relocation requirements relevant to the specific species identified. ▶ Clearing extents will be limited to the area of the permanent and temporary works, avoiding impacts to native vegetation and habitats as far as practicable.

Delivery phase	Aspect	Proposed mitigation measures
Pre-construction/ Construction	Riparian vegetation and aquatic habitats	<ul style="list-style-type: none"> ▶ Plant-maintenance activities and refuelling must be carried out a minimum of 50 m from riparian vegetation and waterways, where practical, with appropriate interception measures in place to avoid impacts to waterways, aquatic habitats, and groundwater. Where this cannot be achieved, a risk-management approach will be applied with additional management controls applied appropriate to the level of environmental risk. ▶ The Surface Water Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ▶ Works within or adjacent to watercourses will be conducted in accordance with the intent of: <ul style="list-style-type: none"> ▶ <i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i> (DPI, 2013) ▶ <i>Guidelines for controlled activities on waterfront land</i> (DPI, 2012) ▶ The salvage and relocation of fish within isolated aquatic environments will be managed in accordance with the <i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i> (DPI, 2013) ▶ <i>Why do fish need to cross the road? Fish passage requirements for waterway crossings</i> (DPI, 2003). ▶ In the event of a spill incident during construction, any impacted aquatic environments will be assessed for the presence of fauna. If necessary, salvage and recovery efforts will be undertaken.
	Flora	<ul style="list-style-type: none"> ▶ Minimise clearance of remnant vegetation to that necessary for construction. Ensure all necessary permits and approvals are in place prior to the commencement of construction ▶ Clearly mark designated revegetation/rehabilitation zones and other no-go areas (including large significant trees) before any vegetation clearing. High-visibility tape, barricade webbing or similar should be used. All contractors to be briefed on clearing requirements and restrictions (including fines) to prevent over-clearing of these areas. ▶ Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species ▶ Topsoil stockpiles will be a maximum of 2.5 m in height to avoid heat sterilisation of the seed bank ▶ Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species such as slender Darling-pea, silky swainson-pea and winged peppergrass.
	Fauna fencing	<ul style="list-style-type: none"> ▶ Any required fauna fencing will be installed in accordance with the fencing strategy, which will be finalised and documented in the detailed design.
	Weeds and pests	<ul style="list-style-type: none"> ▶ The Biosecurity Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ▶ The effectiveness of weed hygiene measures will be monitored as a component of the environmental monitoring procedure for the proposal ▶ Vegetation material will be managed with a general biosecurity duty to prevent, eliminate or minimise any cross-contamination due to the spreading of known weeds ▶ ARTC's Enviroline will be advertised for the proposal to enable members of the public to notify ARTC of issues, including concerns regarding weeds and pests.
	Erosion and sediment control	<ul style="list-style-type: none"> ▶ Implement the Soil Management Sub-plan including erosion and sediment controls as a component of the CEMP.

Delivery phase	Aspect	Proposed mitigation measures
Pre-construction/ Construction	Rehabilitation and landscaping	<ul style="list-style-type: none"> ▶ The Rehabilitation and Landscaping Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ▶ Rehabilitation of disturbed areas will be undertaken progressively and in accordance with the Rehabilitation Management Sub-plan.
Operation	Riparian vegetation and aquatic habitats	<ul style="list-style-type: none"> ▶ Maintenance activities within or adjacent to watercourses will be conducted in accordance with relevant NSW policies and guidelines.
	Weeds and pests	<ul style="list-style-type: none"> ▶ Weed-management protocols for the operational rail corridor and other ARTC facilities will be in accordance with the requirements of the <i>Biosecurity Act 2015</i> (Cth) and incorporated into the OEMP. These protocols will include: <ul style="list-style-type: none"> ▶ Site hygiene and waste management procedures to deter pest animals ▶ Weed surveillance and treatment during operation and maintenance activities ▶ Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of MNES or BC Act-listed ecological receptors habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides. ▶ Erosion and sediment control risks associated with broad scale weed removal or treatment. ▶ ARTC's Enviroline will be advertised for the proposal to enable members of the public to notify ARTC of issues, including concerns regarding weeds and pests.
	Fauna fencing	<ul style="list-style-type: none"> ▶ Fauna fencing, and adjacent vegetation clearance zones (3 m), will be inspected and maintained during operation to retain the fauna fencing integrity ▶ Vegetation maintenance on the habitat side of the fauna exclusion fencing associated with fauna passages would be required to ensure that species cannot use vegetation to climb onto the exclusion fencing.

11.10 Significance of potential impacts

11.10.1 Impact assessment under the Biodiversity Assessment Method

The information below is based on the assumed presence of all ecosystem and species credit species listed within the BAM Calculator. Further details related to the BAM assessment are provided in Appendix B: Biodiversity Technical Report. The outputs of the BAM Calculator are provided below and relate to the specific impact area and required ecosystem credit points associated with the proposed level of disturbance. The magnitude of ecosystem credit points are proportional to the significance of disturbance.

A summary of the outputs from the BAM Calculator in relation to PCTs, species credit species and paddock trees is provided in Table 11.13, Table 11.14 and Table 11.15 respectively.

TABLE 11.13 PLANT COMMUNITY TYPES REQUIRING OFFSET AND THE TOTAL ECOSYSTEM CREDITS REQUIRED WITHIN RAIL ALIGNMENT AND BORROW PITS

IBRA subregion	Vegetation zone	Associated PCT	SAIL Candidate	Vegetation Integrity score	Total area to be impacted (ha)	Ecosystem credits required
Rail Alignment						
Northern Basalts	35_NB_Low	35	Yes	1.34	4.9	0
Northern Basalts	35_NB_High	35	Yes	85.2	10	425
Northern Basalts	53_NB_Medium	53	No	79.5	5.8	202
Northern Basalts	55_NB_High	55	No	26.0	0.5	7
Northern Basalts	56_NB_Low	56	No	19.6	38.4	377
Northern Basalts	56_NB_Medium	56	No	49.3	12.3	304
Northern Basalts	56_NB_High	56	No	62.1	27.9	866
Northern Basalts	98_NB_High	98	No	67.7	1.8	45
Northern Basalts	244_NB_Low	244	No	18.3	1.1	10
Northern Basalts	244_NB_Medium	244	No	51.0	4.7	120
Northern Basalts	244_NB_High	244	No	46.1	10.1	234
Total					117.5	2,590
Northern Outwash	27_NO_Low	27	No	19.0	4.3	41
Northern Outwash	27_NO_Medium	27	No	71.4	0.01	1
Northern Outwash	35_NO_Low	35	Yes	26.2	4.7	61
Northern Outwash	35_NO_High	35	Yes	84.6	4.2	176
Northern Outwash	36_NO_Medium	36	No	55.4	0.5	12
Northern Outwash	36_NO_High	36	No	65.5	0.4	13
Northern Outwash	56_NO_Low	56	No	28.0	47.4	665
Northern Outwash	56_NO_Medium	56	No	29.1	2.3	33
Northern Outwash	56_NO_High	56	No	43.1	2.7	57
Total					66.51	1,059

IBRA subregion	Vegetation zone	Associated PCT	SAIL Candidate	Vegetation Integrity score	Total area to be impacted (ha)	Ecosystem credits required
Castlereagh-Barwon	36_CB_Medium	36	No	69.5	5.6	171
Castlereagh-Barwon	36_CB_High	36	No	86.5	0.7	27
Castlereagh-Barwon	52_CB_Medium	52	No	84.3	42.0	1,768
Castlereagh-Barwon	56_CB_Low	56	No	41.0	14.3	293
Castlereagh-Barwon	56_CB_Medium	56	No	69.5	14.7	509
Castlereagh-Barwon	192_CB_Low	192	No	25.0	3.0	28
Castlereagh-Barwon	192_CB_Medium	192	No	45.0	5.3	89
Castlereagh-Barwon	244_CB_Low	244	No	37.3	9.5	177
Castlereagh-Barwon	244_CB_Medium	244	No	64.6	3.6	115
Castlereagh-Barwon	247_CB_Low	247	No	39.8	4.4	76
Castlereagh-Barwon	247_CB_Medium	247	No	40.2	6.9	121
Castlereagh-Barwon	628_CB_Medium	628	No	86.9	11.7	509
Castlereagh-Barwon	628_CB_Low	628	No	21.2	21.1	223
Total					142.8	4,106
Total Alignment					326.81	7,755
Borrow pits						
Northern Basalts	BP9_35_High	35	Yes	76.3	21.8	834
Northern Basalts	BP11_35_Low	35	Yes	31.3	0.9	14
Northern Basalts	BP11_35_High	35	Yes	54.8	18.5	506
Northern Basalts	BP25_35_High	35	Yes	30.6	2.4	36
Northern Basalts	BP8_56_Medium	56	No	74.4	21.1	787
Northern Basalts	BPFFJVS1_147_Medium	147	No	56.1	3.1	88
Northern Basalts	BPFFJVS1_147_High	147	No	51.4	1.5	38
Northern Basalts	BP9_418_Low	418	No	5.9	1.04	0
Northern Basalts	BP9_418_Medium	418	No	39.4	6.07	90
Northern Basalts	BP9_418_High	418	No	63.3	21.19	503
Northern Basalts	BP25_418_Low	418	No	17.2	2.1	13
Northern Basalts	BP25_418_Medium	418	No	42.3	1.5	23
Total					101.2	2,932

IBRA subregion	Vegetation zone	Associated PCT	SAIL Candidate	Vegetation Integrity score	Total area to be impacted (ha)	Ecosystem credits required
Northern Outwash	BP7_35_Low	35	Yes	25.5	7.7	99
Northern Outwash	BP7_35_High	35	Yes	58.3	17.5	511
Northern Outwash	BPFFJVS2_35_Low	35	Yes	28.4	3.2	46
Northern Outwash	BP26_35_Low	35	Yes	27.8	0.9	13
Northern Outwash	BP26_35_Medium	35	Yes	51.1	3.3	84
Northern Outwash	BP26_35_High	35	True	61.54	1.1	32
Northern Outwash	BP7_56_Low	56	No	28.3	0.8	11
Northern Outwash	BP7_56_High	56	No	36.6	21.3	390
Northern Outwash	BP13_98_Low	98	No	17.4	1	6
Northern Outwash	BP13_98_High	98	No	54.4	1.5	30
Northern Outwash	BP5_192_Low	192	No	29.0	2.5	27
Northern Outwash	BP5_192_Medium	192	No	32.8	7.6	94
Northern Outwash	BP5_192_High	192	No	45.6	10.0	172
Northern Outwash	BPFFJVS2_418_Medium	418	No	25.0	7.3	68
Northern Outwash	BPFFJVS2_418_High	418	No	35.7	8.2	109
Total					93.9	1,692
Total Borrow pits					195,1	4,824
Total Overall					521.91	12,579

TABLE 11.14 SPECIES CREDIT SPECIES REQUIRING OFFSET AND THE NUMBER OF SPECIES CREDITS REQUIRED

Species name	Scientific name	SAII Candidate	Northern Basalts Number of credits (Alignment)	Northern Outwash Area Number of credits (Alignment)	Castlereagh-Barwon Area Number of credits (Alignment)	BP5	BP7	BP8	BP9	BP11	BP13	BP25	BP26	BP1	BP2	Total number of credits
Flora																
Belson's panic	<i>Homopholis belsonii</i>	No	2,436	1,032	2,862	N/A	1,011	787	834	518	49	36	129	126	46	9,866
Bluegrass	<i>Dichanthium setosum</i>	No	1,908	1,032	N/A	N/A	1,011	787	834	520	N/A	85	129	N/A	283	6,589
Braid fern	<i>Platyzoma microphyllum</i>	No	346	N/A	338	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	684
Creeping tick-trefoil	<i>Desmodium campylocaulon</i>	No	458	278	1,768	N/A	610	N/A	834	520	N/A	36	129	N/A	46	4,679
Cyperus conicus	<i>Cyperus conicus</i>	No	1,554	754	802	N/A	401	787	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,298
Finger panic grass	<i>Digitaria porrecta</i>	No	464	1,032	3,594	N/A	1,011	787	834	518	N/A	36	129	N/A	46	8,451
Native Milkwort	<i>Polygala linariifolia</i>	No	N/A	N/A	156	389	N/A	N/A	790	N/A	N/A	49	N/A	N/A	237	1,621
Phyllanthus maderaspatensis	<i>Phyllanthus maderaspatensis</i>	No	N/A	N/A	435	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	435
Pine donkey orchid	<i>Diuris tricolor</i>	No	1,159	N/A	N/A	N/A	N/A	590	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,749
Scant Pomaderris	<i>Pomaderris queenslandica</i>	No	N/A	N/A	N/A	N/A	N/A	N/A	790	N/A	N/A	49	N/A	N/A	N/A	839
Silky swainson-pea	<i>Swainsona sericea</i>	No	1,971	N/A	N/A	N/A	N/A	787	790	N/A	N/A	49	N/A	N/A	N/A	3,597
Slender darling pea	<i>Swainsona murrayana</i>	No	2,366	988	3,819	N/A	610	787	834	518	N/A	85	129	N/A	46	10,182
Tylophora	<i>Tylophora linearis</i>		N/A	N/A	N/A	N/A	N/A	N/A	790	N/A	N/A	49	N/A	N/A	237	1,076

Species name	Scientific name	SAII Candidate	Northern Basalts Number of credits (Alignment)	Northern Outwash Area Number of credits (Alignment)	Castlereagh-Barwon Area Number of credits (Alignment)	BP5	BP7	BP8	BP9	BP11	BP13	BP25	BP26	BP1	BP2	Total number of credits
Winged peppercress	<i>Lepidium monoplocoides</i>	No	N/A	N/A	3,819	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,819
Fauna																
Border thick-tailed gecko	<i>Uvidicolus linearis</i>	No	N/A	N/A	N/A	N/A	N/A	N/A	790	N/A	N/A	49	N/A	N/A	N/A	839
Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat	<i>Setirostris eleryi</i>	No	2,436	1,018	2,192	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,646
Cotton Pygmy-Goose	<i>Nettapus coromandelianus</i>	No	231	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	231
Eastern pygmy-possum	<i>Cercartetus nanus</i>	No	354	N/A	N/A	N/A	N/A	N/A	790	N/A	N/A	N/A	N/A	N/A	N/A	1,144
Glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	No	1,531	108	1,549	350	390	787	790	N/A	N/A	31	N/A	N/A	237	5,773
Koala	<i>Phascolarctos cinereus</i>	No	N/A	N/A	31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31
Large-eared pied bat	<i>Chalinolobus dwyeri</i>	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Masked owl	<i>Tyto novaehollandiae</i>	No	2,016	N/A	1,040	N/A	N/A	787	1,624	504	N/A	N/A	N/A	126	N/A	6,097
Pale imperial hairstreak	<i>Jalmenus eubulus</i>	Yes	638	265	N/A	N/A	767	N/A	1,250	756	N/A	55	173	N/A	N/A	3,904
Pale-headed snake	<i>Hoplocephalus bitorquatus</i>	No	2,600	822	3,453	389	401	787	787	N/A	N/A	N/A	N/A	N/A	237	9,476
Red-tailed black-cockatoo (inland subspecies)	<i>Calyptorhynchus banksii samueli</i>	No	N/A	N/A	3,317	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,317

Species name	Scientific name	SAII Candidate	Northern Basalts Number of credits (Alignment)	Northern Outwash Area Number of credits (Alignment)	Castlereagh-Barwon Area Number of credits (Alignment)	BP5	BP7	BP8	BP9	BP11	BP13	BP25	BP26	BP1	BP2	Total number of credits
Rufous bettong	<i>Aepyprymnus rufescens</i>	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
Squirrel Glider	<i>Petaurus norfolcensis</i>	No	7	27	325	N/A	N/A	N/A	790	N/A	N/A	31	N/A	31	N/A	1,211
Zigzag Velvet Gecko	<i>Amalosia rhombifer</i>	No	N/A	N/A	N/A	N/A	N/A	N/A	790	N/A	N/A	49	N/A	N/A	N/A	839
Total of all species credits			22,475	7,356	29,500	1,128	6,212	7,673	14,941	3,854	49	689	818	283	1,415	96,393

TABLE 11.15 PADDOCK TREE ASSESSMENT RESULTS

Location	PCT	Common name	Scientific name	Number	Diameter at Breast Height Category	Contain hollows	Class	Ecosystem Credits
Northern Outwash	56	Poplar Box	<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	1	>50cm	True	3	1
Castlereagh–Barwon	36	River red gum	<i>Eucalyptus camaldulensis</i>	1	>50cm	True	3	1
Total Number Paddock Trees				2				2

11.10.1.1 Serious and irreversible impacts

One PCT and two species credit species were identified by the BAM C as possibly being candidates for serious and irreversible impacts (SAIL) (refer Appendix I) as listed below:

- ▶ PCT35–Brigalow–Belah open forest/woodlands known to occur
- ▶ Pale imperial hairstreak (*Jalmenus eubulus*)—not known to occur
- ▶ Braid fern (*Platyzoma microphyllum*).

SAILs are determined by the following four criteria:

- ▶ Principle 1—species or ecological community currently in a rapid rate of decline
- ▶ Principle 2—species or ecological communities with very small population size
- ▶ Principle 3—species or area of ecological community with very limited geographic distribution
- ▶ Principle 4—species or ecological community that is unlikely to respond to management and is therefore irreplaceable.

In accordance with the SAIL criteria, the following impacts to each SAIL candidate are outlined below:

- ▶ PCT35–Brigalow–Belah open forest/woodlands—some of the threats listed by OEH include land clearing and fragmentation, invasion and establishment of weed species changing community structure and floristic composition, overgrazing by domestic stock, spray drift of herbicides and pesticides, fragmentation resulting in edge effects, lack of value and understanding of the TEC by landowners.

Total area of impact for PCT35 (excluding low quality, which requires no further assessment under BAM) is 101.1 ha. This includes vegetation within the alignment corridor and six borrow pits, one of which (BP7) overlaps the alignment corridor. This represents a removal of 0.008 per cent of the remaining Brigalow community within NSW. The patch of vegetation through which the existing rail line is located is approximately 30 ha in size, with around 1.5 ha of low quality brigalow being impacted as part of the proposal.

Relocation of the rail line to avoid this section of vegetation would result in further clearing and disturbance of other areas. Wherever possible, disturbance to this vegetation community will be reduced to the least area practicable for construction purposes. Wherever practicable, no laydown or access roads will be developed through this vegetation community.

- ▶ Pale imperial hairstreak (*Jalmenus eubulus*)—the main threats listed for the species are loss and disturbance to old-growth brigalow-dominated woodlands, lack of knowledge about the species, and lack of ecological information. The combination of the extensive reduction in habitat, specialised habitat requirements, the dependence on a single species of host plant and an obligate relationship with specific ants, render this species at extremely high risk of extinction in NSW. Suitable habitat does occur within the subject land and, therefore, targeted surveys should be conducted at the appropriate times (January, February and March).
- ▶ Braid fern (*Platyzoma microphyllum*)—the main threats listed for the species are loss and disturbance to the sandy damp habitat that it requires, including grazing and trampling by livestock and feral pigs. The habitats that the species requires are generally highly ephemeral.

11.10.2 Impact assessment under Significant Impact Assessment Methodology

Estimation of the potential magnitude of disturbance was undertaken for each of the ecological receptors (MNES) identified during the desktop and field components of the proposal. This was achieved using predictive habitat modelling, which was supported by field validation, government geospatial information system (GIS) datasets and material gathered during the field component of the assessment. The predictive mapping outputs identified areas of general, essential and core habitat for each MNES, including threatened flora and fauna and is displayed in Appendix B: Biodiversity Technical Report and Appendix S: Aquatic Biodiversity Technical Report.

The subject land was also used to determine the initial disturbance area (including consideration of design mitigation measures) as a percentage of the extent of the ecological receptor within the broader proposal context (i.e. within a 1 km buffer of the alignment centreline). The percentage was then used to determine relative disturbance magnitude.

Calculated estimates of potential disturbance magnitudes for each of the ecological receptors is provided in Table 11.16.

TABLE 11.16 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE FOR EACH OF THE ECOLOGICAL RECEPTORS IDENTIFIED FOR THE PROPOSAL

Ecological receptor	Total coverage of ecological receptor within the context area (1 km buffer). Context area extent = 12783.38 ha	Total unmitigated potential disturbance area associated with the subject land. Subject land extent = 700.86 ha	Percentage (%) disturbance to ecological receptors within the subject land based on the unmitigated potential disturbance	Magnitude of disturbance area ^{1,2}
Threatened ecological communities (EPBC Act)				
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW (NSW) and southern Queensland	665.50	41.98	6.31	Moderate
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	456.85	75.21	16.46	High
Weeping Myall woodlands	32.16	0.03	0.09	Negligible
Poplar box grassy woodlands on Alluvial Plains	1,505.51	119.48	7.94	Moderate
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	33.64	4.60	13.67	High
Threatened flora (EPBC Act)				
Bluegrass (<i>Dichanthium setosum</i>)	2,951.24	282.22	9.56	Moderate
Belson's panic (<i>Homopholis belsonii</i>)	3,404.65	389.24	11.43	Moderate
<i>Tylophora linearis</i>	132.83	47.37	35.66	High
Ooline (<i>Cadellia pentastylis</i>) 3	128.83	0.00	0.00	N/A ⁴
Slender Darling-pea (<i>Swainsona murrayana</i>)	3,041.37	322.74	10.61	Moderate
Austral toadflax (<i>Thesium australe</i>)	106.11	0.00	0.00	N/A
Threatened fauna (EPBC Act)				
Australasian bittern (<i>Botaurus poiciloptilus</i>)	3,533.89	218.25	6.18	Moderate
Australian painted-snipe (<i>Rostratula australis</i>)	3,478.57	192.89	5.55	Moderate
Border thick-tailed gecko (<i>Uvidicolus sphyrurus</i>)	194.68	67.18	34.51	High
Corben's long-eared bat (<i>Nyctophilus corbeni</i>)	3,001.79	282.74	9.42	Moderate

Ecological receptor	Total coverage of ecological receptor within the context area (1 km buffer). Context area extent = 12783.38 ha	Total unmitigated potential disturbance area associated with the subject land. Subject land extent = 700.86 ha	Percentage (%) disturbance to ecological receptors within the subject land based on the unmitigated potential disturbance	Magnitude of disturbance area ^{1,2}
Curlew sandpiper (<i>Calidris ferruginea</i>)	2,977.18	91.96	3.09	Moderate
Dunmall's snake (<i>Furina dunmali</i>)	459.29	75.39	16.42	High
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	3,514.35	261.45	7.44	Moderate
Grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	2,662.68	277.87	9.91	Moderate
Koala (<i>Phascolarctos cinereus</i>)	2,743.08	323.12	10.41	Moderate
Large-eared pied bat (<i>Chalinolobus dwyeri</i>)	357.15	71.79	20.10	High
Painted honeyeater (<i>Grantiella picta</i>)	3,046.38	310.93	9.87	Moderate
Red goshawk (<i>Erythrorchis radiatus</i>)	61.23	4.03	6.57	Moderate
Spot-tailed quoll (Southeastern mainland population) (<i>Dasyurus maculatus maculatus</i>)	24.15	1.15	4.78	Moderate
Swift parrot (<i>Lathamus discolor</i>)	386.14	63.64	16.48	High
Murray cod (<i>Maccullochella peelii</i>)	38.12	1.51	3.96	Moderate
Aquatic threatened species, populations and EECs (FM Act)				
Darling River snail	38.13	1.51	3.96	Moderate
Southern purple spotted gudgeon	38.13	1.51	3.96	Moderate
Eel-tailed catfish (Murray–Darling population)	38.13	1.51	3.96	Moderate
Western olive perchlet (Western population)	38.13	1.51	3.96	Moderate
Darling River EEC	38.13	1.51	3.96	Moderate
Key Fish Habitats				
Type 1 and Type 3 fish habitat	396.19	14.60	3.69	Moderate

Table notes:

1. There is potential for each of the ecological receptor impacts to overlap spatially. As a result, addition of disturbance values presented in the above table would not represent a true reflection of the total disturbance footprint.
2. Major An impact that is widespread, permanent and results in substantial irreversible change to the ecological receptor. Avoidance through appropriate design responses or the implementation of environmental management controls are required to address the impact. (e.g. greater than 50 per cent of the habitat within the greater area disturbed). High An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the ecological receptor. Avoidance through appropriate design responses or the implementation of site-specific environmental management controls are required to address the impact (e.g. between 13–50 per cent of the habitat within the greater area disturbed). Moderate An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the proposal is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls (e.g. between 2–13 per cent of the habitat within the greater area disturbed). Low A localised impact that is temporary or short-term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls (e.g. between 1–2 per cent of the habitat within the greater area disturbed). Negligible An extremely localised impact that is barely discernible and is effectively mitigated through standard environmental management controls (e.g. less than 1 per cent of the habitat within the greater area disturbed).
3. Predictive habitat modelling predicted 0 ha of habitat for *Cadellia pentastylis* and *Thesium australe* within the subject land and was therefore no longer considered an ecological receptor.
4. Ecological receptors that recorded a magnitude of 'N/A' were not subject to an assessment of impact significance as the ecological receptor was not subject to impacts.

11.10.3 Initial significance of potential impacts

The initial significance of impacts resulting from initial mitigation measures were determined for each phase of the proposal for the identified ecological receptors (except those assessed through the BAM). Sensitivity of the ecological receptor and the magnitude of potential impacts to the ecological receptor allowed calculation of significance of impact.

Following the calculation of significance for the initial mitigation scenario (including the design mitigation measures), the proposal impact mitigation measures (excluding the use of offsets) were considered and the significance then recalculated using the adjusted magnitude, where applicable. The calculated significance of impacts is presented in Table 11.17. The initial magnitude of impacts used in Table 11.17 takes into consideration those associated with direct impacts associated with the direct removal of habitat (refer Table 11.16) and also considers those impacts associated with air quality; surface water and hydrology; groundwater; and noise and vibration.

The impacts to ecological receptors displayed in Table 11.17 have been grouped by:

- ▶ Ecological receptor type (e.g. Commonwealth-listed threatened species, Commonwealth-listed TECs)
- ▶ Sensitivity (e.g. low, moderate, high)
- ▶ Magnitude of direct disturbance (refer Table 11.16).

Using the information presented within Table 11.18, the significance of initial impacts were determined for each phase of the proposal for the identified ecological receptors (except those assessed through the BAM). The initial impact assessment incorporated the design mitigation measures. Following the calculation of significance for the initial impact scenario, the proposed additional mitigation measures were considered and the significance then recalculated using the adjusted magnitude, where applicable. The calculated significance of impacts is presented in Table 11.16.

In addition to the mitigation measures presented in Section 11.9, rehabilitation works may also be an effective mitigation measure to minimise potential impacts; however, the potential significant residual adverse impacts are likely to require some level of offset.

TABLE 11.17 INITIAL SIGNIFICANCE IMPACT ASSESSMENT OF THE PROPOSAL ON IDENTIFIED ECOLOGICAL RECEPTORS

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
<p>Commonwealth-significant ecological constraint (community listed under the EPBC Act):</p> <ul style="list-style-type: none"> ▶ Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) ▶ Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions 	High	Construction	<ul style="list-style-type: none"> ▶ Habitat loss from vegetation clearing/removal ▶ Fauna species injury or mortality ▶ Reduction in biological viability of soil to support plant growth due to soil compaction ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Reduction in the connectivity of biodiversity corridors ▶ Edge effects ▶ Habitat fragmentation ▶ Barrier effects ▶ Noise, dust and light impacts ▶ Increase in waste (litter) ▶ Erosion and sedimentation ▶ Aquatic habitat degradation 	Major	Major	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Aquatic fauna (design and construction) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre-construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) ▶ Fauna passage (design and construction) 	High	Major (refer Section 11.12 for impact assessment under the AIAM as per the Significant Impact Guidelines Version 1.1—MNES)

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
Commonwealth- significant ecological constraint (community listed under the EPBC Act): <ul style="list-style-type: none"> Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions 	High	Commissioning and reinstatement	<ul style="list-style-type: none"> Displacement of flora and fauna species from invasion of weed and pest species 	Low	Moderate	<ul style="list-style-type: none"> Flora and fauna (design, preconstruction and construction proposed mitigation measures) Weeds and pests (preconstruction and construction mitigation measures) Erosion and sediment control (pre-construction and construction) Riparian vegetation and aquatic habitats (construction) Landscape, rehabilitation and stabilisation (design, pre-construction, construction) 	Negligible	Low
		Operation	<ul style="list-style-type: none"> Fauna species injury or mortality Displacement of flora and fauna species from invasion of weed and pest species 	Low	Moderate	<ul style="list-style-type: none"> Weeds and pests (operation) Riparian vegetation and aquatic habitats (operation) Fauna passage (design and construction) Fauna fencing (design and construction) 	Negligible	Low

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
<p>Commonwealth-significant ecological constraint (community listed under the EPBC Act):</p> <ul style="list-style-type: none"> ▶ Poplar box grassy woodlands on alluvial plains ▶ Natural grasslands on basalt and fine-textured alluvial plains of northern NSW (NSW) and southern Queensland 	High	Construction	<ul style="list-style-type: none"> ▶ Habitat loss from vegetation clearing/removal ▶ Fauna species injury or mortality ▶ Reduction in biological viability of soil to support plant growth due to soil compaction ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Reduction in the connectivity of biodiversity corridors ▶ Edge effects ▶ Habitat fragmentation ▶ Barrier effects ▶ Noise, dust and light impacts ▶ Increase in waste (litter) ▶ Erosion and sedimentation ▶ Aquatic habitat degradation 	High	Major	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre-construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) 	Moderate	High (refer Section 11.12 for impact assessment under the AIAM as per the Significant Impact Guidelines Version 1.1—MNES)

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
Commonwealth- significant ecological constraint (community listed under the EPBC Act): <ul style="list-style-type: none"> ▶ Poplar box grassy woodlands on alluvial plains ▶ Natural grasslands on basalt and fine-textured alluvial plains of northern NSW (NSW) and southern Queensland 	High	Commissioning and reinstatement	<ul style="list-style-type: none"> ▶ Displacement of flora and fauna species from invasion of weed and pest species 	Low	Moderate	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre-construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) ▶ Landscape, rehabilitation and stabilisation (design, pre-construction, construction) 	Negligible	Low
		Operation	<ul style="list-style-type: none"> ▶ Fauna species injury or mortality ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts ▶ Aquatic habitat degradation 	Low	Moderate	<ul style="list-style-type: none"> ▶ Weeds and pests (operation) ▶ Riparian vegetation and aquatic habitats (operation) ▶ Fauna passage (design and construction) ▶ Fauna fencing (design and construction) 	Negligible	Low

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
Commonwealth- significant ecological constraint (community listed under the EPBC Act): <ul style="list-style-type: none"> ▶ Weeping Myall woodlands 	High	Construction	<ul style="list-style-type: none"> ▶ Habitat loss from vegetation clearing/removal ▶ Fauna species injury or mortality ▶ Reduction in biological viability of soil to support plant growth due to soil compaction ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Reduction in the connectivity of biodiversity corridors ▶ Edge effects ▶ Habitat fragmentation ▶ Barrier effects ▶ Noise, dust and light impacts ▶ Increase in waste (litter) ▶ Erosion and sedimentation ▶ Aquatic habitat degradation 	Low	Moderate	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre- construction and construction) ■ Riparian vegetation and aquatic habitats (construction) 	Negligible	Low

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
Commonwealth- significant ecological constraint (community listed under the EPBC Act): <ul style="list-style-type: none"> ▶ Weeping Myall woodlands 	High	Commissioning and reinstatement	<ul style="list-style-type: none"> ▶ Displacement of flora and fauna species from invasion of weed and pest species 	Low	Moderate	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre-construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) ▶ Landscape, rehabilitation and stabilisation (design, pre-construction, construction) 	Negligible	Low
		Operation	<ul style="list-style-type: none"> ▶ Fauna species injury or mortality ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts ▶ Aquatic habitat degradation 	Low	Moderate	<ul style="list-style-type: none"> ▶ Weeds and Pests (operation) ▶ Riparian vegetation and aquatic habitats (operation) ▶ Fauna passage (design and construction) ▶ Fauna fencing (design and construction) 	Negligible	Low

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
Commonwealth- significant ecological constraint (species listed under the EPBC Act): Flora: ▶ <i>Tylophora linearis</i> Fauna: ▶ Border thick-tailed gecko (<i>Uvidicolus sphyrurus</i>) ▶ Dunmall's snake (<i>Furina dunmalli</i>) ▶ Large-eared pied bat (<i>Chalinolobus dwyeri</i>) ▶ Swift parrot (<i>Lathamus discolor</i>)	High	Construction	▶ Habitat loss from vegetation clearing/removal ▶ Fauna species injury or mortality ▶ Reduction in biological viability of soil to support plant growth due to soil compaction ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Reduction in the connectivity of biodiversity corridors ▶ Edge effects ▶ Habitat fragmentation ▶ Barrier effects ▶ Noise, dust and light impacts ▶ Increase in waste (litter) ▶ Erosion and sedimentation ▶ Aquatic habitat degradation	Major	Major	▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Aquatic fauna (design and construction) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre- construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) ▶ Fauna passage (design and construction) ▶ Fauna fencing (design and construction)	High	Major (refer Section 11.12 for impact assessment under the AIAM as per the Significant Impact Guidelines Version 1.1— MNES)

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
Commonwealth- significant ecological constraint (species listed under the EPBC Act): Flora: ▶ <i>Tylophora linearis</i> Fauna: ▶ Border thick-tailed gecko (<i>Uvidicolus sphyrurus</i>) ▶ Dunmall's snake (<i>Furina dunmalli</i>) ▶ Large-eared pied bat (<i>Chalinolobus dwyeri</i>) ▶ Swift parrot (<i>Lathamus discolor</i>)	High	Commissioning and reinstatement	▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts	Low	Moderate	▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (construction) ▶ Landscape, rehabilitation and stabilisation (design, pre-construction, construction)	Negligible	Low
		Operation	▶ Fauna species injury or mortality ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts ▶ Aquatic habitat degradation	Low	Moderate	▶ Weeds and pests (operations) ▶ Riparian vegetation and aquatic habitats (operations) ▶ Fauna fencing (operations) ▶ Fauna passage (design and construction)	Negligible	Low

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
<p>Commonwealth-significant ecological constraint (Species listed under the EPBC Act):</p> <p>Flora:</p> <ul style="list-style-type: none"> ▶ Bluegrass (<i>Dichanthium setosum</i>) ▶ Belson's panic (<i>Homopholis belsonii</i>) ▶ Slender darling-pea (<i>Swainsona murrayana</i>) <p>Fauna:</p> <ul style="list-style-type: none"> ▶ Australasian bittern (<i>Botaurus poiciloptilus</i>) ▶ Australian painted-snipe (<i>Rostratula australis</i>) ▶ Corben's long-eared bat (<i>Nyctophilus corbeni</i>) ▶ Curlew sandpiper (<i>Calidris ferruginea</i>) ▶ Five-clawed worm-skink (<i>Anomalopus mackayi</i>) 	High	Construction	<ul style="list-style-type: none"> ▶ Habitat loss from vegetation clearing/removal ▶ Fauna species injury or mortality ▶ Reduction in biological viability of soil to support plant growth due to soil compaction ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Reduction in the connectivity of biodiversity corridors ▶ Edge effects ▶ Habitat fragmentation ▶ Barrier effects ▶ Noise, dust and light impacts ▶ Increase in waste (litter) ▶ Erosion and sedimentation ▶ Aquatic habitat degradation 	High	Major	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Aquatic fauna (design and construction) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre-construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) ▶ Fauna passage (design and construction) ▶ Fauna fencing (design and construction) 	Moderate	High (refer Section 11.12 for impact assessment under the AIAM as per the Significant Impact Guidelines Version 1.1—MNES)

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
Fauna (continued): <ul style="list-style-type: none"> ▶ Grey-headed flying-fox (<i>Pteropus poliocephalus</i>) ▶ Koala (<i>Phascolarctos cinereus</i>) ▶ Painted honeyeater (<i>Grantiella picta</i>) ▶ Red goshawk (<i>Erythrionchis radiatus</i>) ▶ Spot-tailed quoll (Southeastern mainland population) (<i>Dasyurus maculatus maculatus</i>) ▶ Murray cod (<i>Maccullochella peelii</i>) 	High	Commissioning and reinstatement	<ul style="list-style-type: none"> ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts 	Low	Moderate	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (construction) ▶ Landscape, rehabilitation and stabilisation (design, pre-construction, construction) 	Negligible	Low
		Operation	<ul style="list-style-type: none"> ▶ Fauna species injury or mortality ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts ▶ Aquatic habitat degradation 	Low	Moderate	<ul style="list-style-type: none"> ▶ Weeds and pests (operations) ▶ Riparian vegetation and aquatic habitats (operations) ▶ Fauna fencing (operations) ▶ Fauna passage (design and construction) 	Negligible	Low

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
State-significant ecological constraint (species/populations/com munities listed under the FM Act as threatened): Aquatic fauna: <ul style="list-style-type: none"> ▶ Darling River snail (<i>Notopala sublineata</i>)^ ▶ Southern purple spotted gudgeon (<i>Mogurnda adspersa</i>)^ ▶ Eel-tailed catfish (Murray-Darling population) (<i>Tandanus tandanus</i>)^ ▶ Western olive perchlet (western population) (<i>Ambassis agassizi</i>)^ ▶ Darling River EEC 	High	Construction	<ul style="list-style-type: none"> ▶ Aquatic fauna species injury or mortality ▶ Displacement of aquatic flora and fauna species from invasion of aquatic weed and pest species ▶ Habitat fragmentation ▶ Barrier effects ▶ Erosion and sedimentation ▶ Aquatic habitat degradation 	High	Major	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Aquatic fauna (design and construction) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre- construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) ▶ Fauna passage (design and construction) 	Moderate	High (refer Section 11.13 for impact assessment under FM Act significant impact assessment)

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
State-significant ecological constraint (species/populations/com munities listed under the FM Act as threatened): Aquatic fauna: ▶ Darling River snail (<i>Notopala sublineata</i>)^ ▶ Southern purple spotted gudgeon (<i>Mogurnda adspersa</i>)^ ▶ Eel-tailed catfish (Murray-Darling population) (<i>Tandanus tandanus</i>)^ ▶ Western olive perchlet (western population) (<i>Ambassis agassizii</i>)^ ▶ Darling River EEC	High	Commissioning and reinstatement	▶ Noise, dust and light impacts ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Aquatic habitat degradation	Low	Moderate	▶ Aquatic fauna (design and construction) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre- construction and construction) ▶ Riparian vegetation and aquatic habitats (construction)	Negligible	Low
		Operation	▶ Fauna species injury or mortality ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts ▶ Aquatic habitat degradation	Low	Moderate	▶ Weeds and pests (operations) ▶ Riparian vegetation and aquatic habitats (operations) ▶ Fauna fencing (operations)	Negligible	Low

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
State-significant ecological constraint (KFH listed under the FM Act): Type 1 and Type 3 fish habitat	Moderate	Construction	<ul style="list-style-type: none"> ▶ Habitat loss from vegetation clearing/removal ▶ Fauna species injury or mortality ▶ Reduction in biological viability of soil to support plant growth due to soil compaction ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Reduction in the connectivity of biodiversity corridors ▶ Edge effects ▶ Habitat fragmentation ▶ Barrier effects ▶ Noise, dust and light impacts ▶ Increase in waste (litter) ▶ Erosion and sedimentation ▶ Aquatic habitat degradation 	High	High	<ul style="list-style-type: none"> ▶ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▶ Aquatic fauna (design and construction) ▶ Weeds and pests (preconstruction and construction mitigation measures) ▶ Erosion and sediment control (pre-construction and construction) ▶ Riparian vegetation and aquatic habitats (construction) ▶ Fauna passage (design and construction) ▶ Fauna fencing (design and construction) 	Moderate	Moderate (refer Section 11.13 for impact assessment under FM Act significant impact assessment)

Ecological receptor(s)	Sensitivity	Phase	Potential impacts ¹	Initial significance (application of initial mitigation measures in Appendix B: Biodiversity Technical Report)		Proposed additional mitigation measures to be applied (refer Table 11.12)	Residual significance following the application of proposal mitigation measures presented in Table 11.12 ²	
				Magnitude	Significance		Magnitude	Significance ³
State-significant ecological constraint (KFH listed under the FM Act): Type 1 and Type 3 fish habitat	Moderate	Commissioning and reinstatement	<ul style="list-style-type: none"> ▶ Fauna species injury or mortality ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts ▶ Aquatic habitat degradation 	Low	Moderate	<ul style="list-style-type: none"> ▶ Weeds and pests (operations) ▶ Riparian vegetation and aquatic habitats (operations) ▶ Fauna fencing (operations) 	Negligible	Low
		Operation	<ul style="list-style-type: none"> ▶ Fauna species injury or mortality ▶ Displacement of flora and fauna species from invasion of weed and pest species ▶ Noise, dust and light impacts ▶ Aquatic habitat degradation 	Low	Moderate	<ul style="list-style-type: none"> ▶ Weeds and pests (operations) ▶ Riparian vegetation and aquatic habitats (operations) ▶ Fauna fencing (operations) 	Negligible	Low

Table notes:

- Potential impacts to terrestrial and aquatic ecological receptors in the above table are based on those identified in Section 11.8.
 - The use of offsets has not been considered as a mitigation measure for the purposes of proposal mitigation for the assessment of potential impacts. Refer Section 11.15 for information related to the use of offset to compensate proposal related impacts that are not sufficiently reduced in the above table.
 - In instances where the mitigated significance returns a rating of Moderate or above, offsets may be an option to reduce the residual environmental impacts in the long term. Offset for biodiversity values are discussed further in Section 11.15. Refer Adverse Impact Assessment Methodology for MNES where a 'Moderate', 'High' or 'Major' significance rating occurs for MNES and refer to FM Act significant impact assessment for FM Act regulated aquatic ecological receptors.
- [^] Species and populations listed under the FM Act were also subject to an FM Act-significant impact assessment (refer Appendix S: Aquatic Biodiversity Technical Report Technical Report).
- ^{*} Due to the aerial nature of the white-throated needletail (*Hirundapus caudacutus*), impacts of the proposal on the species and its habitat are not considered to be significant. This species is not considered further in the SIAM assessment.

11.11 Summary of impacts to matters of state and national significance

Under the EPBC Act the approval of the Australian Government Minister for the Environment is required for any action that may have a significant impact on MNES or MSES. These are:

- ▶ Listed threatened species and communities
- ▶ Migratory species protected under international agreements
- ▶ Ramsar wetlands of international importance
- ▶ The Commonwealth marine environment
- ▶ The Great Barrier Reef Marine Park
- ▶ World Heritage properties
- ▶ National Heritage places
- ▶ Nuclear actions
- ▶ A water resource, in relation to coal seam gas development and large coal mining development.

The proposal has been referred (EPBC number: 2018/8222) to DAWE, on 12 June 2018 it) and was determined by the department to be a controlled action. DAWE considers that the proposed action has the potential to significantly impact MNES, and must therefore assess the significance of any potential impacts on MNES threatened species and communities. The EPBC Act controlling provisions for the proposed action are:

- ▶ Listed threatened species and communities (section 18 and 18A).

As identified in the SEAR, the DAWE considers that the proposal has the potential to significantly impact the following MNES ecological receptors:

- ▶ Brigalow (*Acacia harpophylla* dominant and co-dominant) (TEC)
- ▶ Coolibah–Black box woodlands of the Darling Riverine plains and the Brigalow Belt south bioregions (TEC)
- ▶ Natural grasslands on basalt and fine textured alluvial plains of northern NSW and southern Queensland (TEC)
- ▶ Weeping Myall woodlands TEC
- ▶ White box–Yellow box–Blakely’s Red Gum grassy woodlands and derived native grassland (TEC)
- ▶ Squatter pigeon (southern) (*Geophaps scripta scripta*)
- ▶ Painted honeyeater (*Grantiella picta*)
- ▶ Murray cod (*Maccullochella peelii*)
- ▶ Large-eared pied bat (*Chalinolobus dwyeri*)
- ▶ Corben’s long-eared bat (*Nyctophilus corbeni*)
- ▶ Koala (*Phascolarctos cinereus*)
- ▶ Ooline (*Cadellia pentastylis*)
- ▶ Bluegrass (*Dichanthium setosum*)
- ▶ Belson’s panic (*Homopholis belsonii*)
- ▶ Slender tylophora (*Tylophora linearis*)
- ▶ Five-clawed worm skink (*Anomalopus mackayi*)
- ▶ Adorned delma (*Delma torquata*)
- ▶ Dunmall’s snake (*Furina dunmali*).

11.11.1 Summary of Commonwealth Matters Assessment

Based on the direct and permanent impacts associated with the proposal, the range of avoidance and the mitigation measures proposed, the proposal is considered likely to result in a significant impact. This is considered likely on two ecological communities and 10 threatened flora and fauna species subject to the BAM assessment pathway that are also protected under the EPBC Act. Impacts of the proposal on these MNES assessed through BAM will be offset in accordance with the BAM guidelines, as detailed in Table 11.18.

TABLE 11.18 LIKE-FOR-LIKE OFFSETS WITHIN THE BIODIVERSITY ASSESSMENT METHOD

Matter	Proposal impact (BAM)	Like-for-like offset in accordance with BAM guidelines
TECs		
Brigalow (<i>Acacia harpophylla</i>) dominant and co-dominant) community	A total of 101.2 ha of this vegetation community will be removed as part of the proposal	601 and 1,919 ecosystem credits will be retired within the alignment and borrow pits, respectively, to offset impacts to this TEC, in accordance with BAM guidelines. This aligns with the high-value PCT 35.
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	A total of 4.6 ha of this vegetation community will be removed as part of the proposal	71 ecosystem credits will be retired for impacts on this TEC within Borrow pit Site 1, in accordance with the BAM guidelines.
Poplar Box grassy woodlands on alluvial plains	A total of 232.2 ha of this vegetation community will be removed as part of the proposal	2,213 and 1,188 ecosystem credits will be retired within the alignment and borrow pits respectively to offset impacts to this TEC, in accordance with the BAM guidelines.
Species credit species		
These credits are based on assumed presence over all potential habitats		
Belson's panic (<i>Homopholis belsonii</i>)	A total of 389 ha of potential habitat will be removed as part of the proposal	6,330 and 3,536 species credits will be retired to offset impacts to this species for the alignment and borrow pits, respectively, in accordance with the BAM guidelines.
Bluegrass (<i>Dichanthium setosum</i>)	A total of 288.46 ha of potential habitat will be removed as part of the proposal	2,940 and 3,649 species credits will be retired to offset impacts to this species for the alignment and borrow pits, respectively, in accordance with the BAM guidelines.
Slender darling pea (<i>Swainsona murrayana</i>)	A total of 401 ha of potential habitat will be removed as part of the proposal	7,173 and 6,009 species credits will be retired to offset impacts to this species for the alignment and borrow pits, respectively, in accordance with BAM guidelines.
<i>Tylophora linearis</i>	A total of 46.29 ha of potential habitat will be removed as part of the proposal	1,076 species credits will be retired to offset impacts to this species within the borrow pits, in accordance with the BAM guidelines.
Winged peppercress (<i>Lepidium monoplacoides</i>)	A total of 127.99 ha of potential habitat will be removed as part of the proposal	3,819 species credits will be retired to offset impacts to this species within the alignment, in accordance with the BAM guidelines.
Border thick-tailed gecko (<i>Uvidicolus sphyrurus</i>)	A total of 30.8 ha of potential habitat will be removed as part of the proposal	839 species credits will be retired to offset impacts to this species within the borrow pits, in accordance with the BAM guidelines
Koala (<i>Phascolarctos cinereus</i>)	A total of 17.12 ha of potential habitat will be removed as part of the proposal	31 species credits will be retired to offset impacts to this species for the alignment, in accordance with the BAM guidelines.
Ecosystem-credit species		
These credits are based on habitat values found within a PCT where that species is considered reliably likely to occur; as such, no individual credits are assigned to each species. Relevant PCTs are listed below		
Australasian bittern (<i>Botaurus poiciloptilus</i>)	36,39,53,247	Combined PCT values refer Appendix B—Biodiversity Technical Report
Swift parrot (<i>Lathamus discolor</i>)	36,39,55,56,98,247	Combined PCT values refer Appendix B—Biodiversity Technical Report
Spotted-tailed quoll (<i>Dasyurus maculatus</i>)	36,192,244,628	Combined PCT values refer Appendix B—Biodiversity Technical Report
Corben's long-eared bat (<i>Nyctophilus corbeni</i>)	35,36,55,56,98,192,244,247	Combined PCT values refer Appendix B—Biodiversity Technical Report
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	39,53	Combined PCT values refer Appendix B – Biodiversity Technical Report

Matter	Proposal impact (BAM)	Like-for-like offset in accordance with BAM guidelines
Painted honeyeater (<i>Grantiella picta</i>)	35,36,55,56,98,192,244,247	Combined PCT values refer Appendix B—Biodiversity Technical Report
Superb parrot (<i>Polytelis swainsonii</i>)	35,36,52,56,98,244,	Combined PCT values refer Appendix B—Biodiversity Technical Report
Grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	35,36,56,147,244,628	Combined PCT values refer Appendix B—Biodiversity Technical Report

11.12 Modelled significant residual impacts to matters of national environmental significance—results

Each MNES considered potentially present has been subject to an assessment of species and habitat resilience and the subsequent AIAM assessment process (refer Appendix B: Biodiversity Technical Report and Appendix S: Aquatic Biodiversity Technical Report for the detailed assessment). From this, the disturbance area of habitat for each MNES representing the significant residual adverse impact to the species and/or its habitat values was defined. The assessment process has the potential to reduce the area of significant residual adverse impact as compared to the overall area of identified impacts. This data is presented in Table 11.19. It should be noted there is significant overlap of the habitat area present between many of the MNES considered present.

The assessment calculations presented in Table 11.19 are associated with direct impacts (i.e. vegetation clearing) within the subject land only and do not account for offsite impacts to adjacent suitable habitat or the resilience of the MNES outside of the subject land.

TABLE 11.19 DISTURBANCE AREA THAT CONSTITUTES A SIGNIFICANT ADVERSE RESIDUAL IMPACT FOR MNES ECOLOGICAL RECEPTORS

MNES	Disturbance that constitutes a Significant Adverse Residual Impact on habitat (ha)	Reduction (%) from the total identified impacts presented in Table 11.16
Flora		
Bluegrass (<i>Dichanthium setosum</i>)	237.10	15.99
Belson's panic (<i>Homopholis belsonii</i>)	346.62	12.30
Slender Darling-pea (<i>Swaivsona murrayana</i>)	280.76	14.95
<i>Tylophora linearis</i>	47.37	0.00
Terrestrial fauna		
Australasian bittern (<i>Botaurus poiciloptilus</i>)	111.41	48.95
Australian painted-snipe (<i>Rostratula australis</i>)	88.68	54.02
Border thick-tailed gecko (<i>Uvidicolus sphyrurus</i>)	67.18	0.00
Corben's long-eared bat (<i>Nyctophilus corbeni</i>)	280.36	0.84
Curlew sandpiper (<i>Calidris ferruginea</i>)	37.01	59.75
Dunmall's snake (<i>Furina dunmalli</i>)	75.39	0.00
Five-clawed work-skink (<i>Anomalopus mackayi</i>)	219.47	16.06
Grey-headed flying fox (<i>Pteropus poliocephalus</i>)	263.93	0.00
Koala (<i>Phascolarctos cinereus</i>)	285.47	0.00
Large-eared pied bat (<i>Chalinolobus dwyeri</i>)	71.79	0.00
Painted honeyeater (<i>Grantiella picta</i>)	292.73	2.68
Red goshawk (<i>Erythrorhynchus radiatus</i>)	4.03	0.00
Spot-tailed quoll (<i>Dasyurus maculatus</i>)	1.15	0.00
Swift parrot (<i>Lathamus discolor</i>)	63.64	0.00

MNES	Disturbance that constitutes a Significant Adverse Residual Impact on habitat (ha)	Reduction (%) from the total identified impacts presented in Table 11.16
Aquatic fauna		
Murray cod (<i>Maccullochella peelii</i>)	1.15	23.59
TECs		
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	75.21	0.00
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW (NSW) and southern Queensland	41.98	0.00
Poplar Box grassy woodlands on alluvial plains	119.48	0.00
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	4.60	0.00

11.13 Summary of significant residual impact under the *Fisheries Management Act*

Following assessments of species and habitat resilience and the subsequent assessment process, the area of habitat proposed for disturbance for each aquatic ecological receptor regulated under the FM Act which represents the significant residual adverse impact to the species, and/or its habitat values, was ascertained. This was assessed using the FM Act-significant impact assessment (refer Appendix S: Aquatic Biodiversity Technical Report Technical Report).

TABLE 11.20 SIGNIFICANT RESIDUAL IMPACT FOR FM ACT ECOLOGICAL RECEPTORS

Environmental receptor	Initial assessment of impact area (ha)	Outcome of FM Act significant impact assessment	Significant residual adversely impacted habitat disturbance area (ha)
Darling River snail	1.51	No significant impact	0.00
Southern purple spotted gudgeon	1.51	No significant impact	0.00
Eel-tailed catfish (Murray–Darling population)	1.51	No significant impact	0.00
Western olive perchlet (Western population)	1.51	No significant impact	0.00
Darling River EEC	1.51	No significant impact	0.00
Type 1 and Type 3 fish habitat	14.60	Significant impact	14.60

11.14 Key Threatening Processes

There are 37 terrestrial key threatening processes (KTP) listed under the BC Act, 15 under the EPBC Act and eight under the FM Act.

Table 11.21 lists each these threatening processes and their applicability to the proposal.

TABLE 11.21 KEY THREATENING PROCESSES AND THEIR APPLICABILITY TO THE PROPOSAL

Key threatening process	BC Act/ EPBC Act/ FM Act	Applicable	Comments
Aggressive exclusion of birds from woodlands and forest habitat by abundant noisy miners (<i>Manorina melanoccephala</i>)	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP. The noisy miner is already ubiquitous across the landscape in degraded and fragmented woodlands and forest habitats.
Alteration of habitat following subsidence due to longwall mining	BC Act	No	The proposal is not considered likely to trigger this KTP.

Key threatening process	BC Act/ EPBC Act/ FM Act	Applicable	Comments
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	BC Act	Yes	Design considerations to reduce any impact on flow regimes are part of the detailed design process
Anthropogenic climate change	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Bushrock removal	BC Act	Yes	The proposal will trigger this KTP should borrow pit 1 or 2 be developed as part of the proposal
Clearing of native vegetation	BC Act and EPBC Act	Yes	The detailed design will determine the final area of native vegetation to be cleared
Competition and grazing by the feral European rabbit (<i>Oryctolagus cuniculus</i>)	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Competition and habitat degradation by feral goats (<i>Capra hircus</i>)	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Competition from feral honey bees (<i>Apis mellifera</i>)	BC Act	No	The proposal is not considered likely to trigger this KTP
Forest eucalypt dieback associated with over-abundant psyllids and bell miners (<i>Manorina melanophrys</i>)	BC Act	No	The proposal is not considered likely to trigger this KTP
Habitat degradation and loss by feral horses (<i>Equus caballus</i>)	BC Act	No	The proposal is not considered likely to trigger this KTP
Herbivory and environmental degradation caused by feral deer	BC Act	No	The proposal is not considered likely to trigger this KTP
High frequency fire resulting in the disruption of lifecycle processes in plants and animals and loss of vegetation structure and composition	BC Act	No	The proposal is not considered likely to trigger this KTP
Importation of red imported fire ants (<i>Solenopsis invicta</i>)	BC Act and EPBC Act	Possible	The proposal is not considered likely to trigger this KTP. Mitigation measures including vehicle and soil hygiene will reduce the risks associated with the KTP.
Infection by <i>Psittacine Circoviral</i> (beak and feather) disease affecting endangered psittacine species and populations	BC Act	No	The proposal is not considered likely to trigger this KTP
Infection of frogs by <i>amphibian chytrid</i> causing the disease <i>chytridiomycosis</i>	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Infection of native plants by <i>Phytophthora cinnamomi</i>	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP. Fill material will be locally sourced. <i>P. cinnamomi</i> is not known to the local area.
Introduction and establishment of exotic rust fungi of the order <i>Pucciniales</i> pathogenic on plants of the family <i>Myrtaceae</i>	BC Act	No	The proposal is not considered likely to trigger this KTP
Introduction of the large earth bumblebee (<i>Bombus terrestris</i>)	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion and establishment of exotic vines and scramblers	BC Act	No	The proposal is not considered likely to trigger this KTP. Where exotic vines already occur within the subject land mitigation measures around the control of weeds will be designed to reduce this risk.

Key threatening process	BC Act/ EPBC Act/ FM Act	Applicable	Comments
Invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>)	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion and establishment of the cane toad (<i>Bufo marinus</i>)	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP as the successful expansion of the species is restricted to their natural climatic ranges
Invasion of native plant communities by African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>)	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i>	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion of native plant communities by exotic perennial grasses	BC Act	Potential	There are large patches on introduced grasses within and adjacent to the proposed works. The mitigation measures will be further developed to address this issue.
Invasion of the yellow crazy ant (<i>Anoplolepis gracilipes</i>) into NSW	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion, establishment and spread of lantana (<i>Lantana camara</i>)	BC Act	Potential	While not recorded within the proposal area Lantana is known to colonise disturbed areas. Mitigation measures including vehicle wash down will help reduce the risks associated with this KTP.
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	BC Act and EPBC Act	Potential	There are several invasive weed species currently recorded within the proposal area. The mitigation measures will help reduce the risk associated with this KTP.
Loss of hollow-bearing trees	BC Act	Yes	The subject land extended out to 500 m from the proposed centreline and areas within the borrow pits. Many known HBTs occur within this area. The mitigation measures will help reduce the risk associated with this KTP.
Loss or degradation (or both) of sites used for hill-topping by butterflies	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation and hybridisation by feral dogs, <i>Canis lupus familiaris</i>	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation by <i>Gambusia holbrooki girard</i> , 1859 (Plague Minnow or Mosquito Fish)	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation by the European Red Fox <i>Vulpes vulpes</i> (Linnaeus 1758)	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Predation by the feral cat <i>Felis catus</i> (Linnaeus 1758)	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Predation by the ship rat <i>Rattus rattus</i> on Lord Howe Island	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation, habitat degradation, competition and disease transmission by feral pigs, <i>Sus scrofa</i>	BC Act and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Removal of dead wood and dead trees	BC Act	Yes	The removal of native vegetation within the final footprint is likely to trigger this KTP. Mitigation measures including restoration of habitat will help to address this issue.

Key threatening process	BC Act/ EPBC Act/ FM Act	Applicable	Comments
Invasion of northern Australia by gamba grass and other introduced grasses	EPBC Act	No	The proposal is not located within northern Australia
Novel biota and their impact on biodiversity	EPBC Act	Potential	The proposal does not involve the introduction of novel biota into Australia. Mitigation measures around weed and pest management will assist in reducing this risk.
Degradation of native riparian vegetation along NSW water courses	FM Act	Potential	Design considerations to reduce any impact on riparian vegetation are part of the detailed design process
Hook and line fishing in areas important for the survival of threatened fish species	FM Act	No	The proposal is not considered likely to trigger this KTP
Human-caused climate change	FM Act	No	The proposal is not considered likely to trigger this KTP
Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams	FM Act	Yes	Design considerations to reduce any impact natural flow regimes are part of the detailed design process
Introduction of fish to waters within a river catchment outside their natural range	FM Act	No	The proposal is not considered likely to trigger this KTP
Introduction of non-indigenous fish and marine vegetation to the coastal waters of NSW	FM Act	No	The proposal is not considered likely to trigger this KTP
Removal of large woody debris from NSW rivers and streams	FM Act	Potential	Design considerations to reduce any impact on large woody debris in rivers and streams are part of the detailed design process
The current shark meshing program in NSW waters	FM Act	No	The proposal is not located in coastal waters

11.15 Biodiversity offsets—approach

Residual impacts are those impacts that remain after the successful implementation of the avoidance hierarchy and mitigation measures. The significance of residual impacts reflects the effectiveness of the proposed mitigation but allows for the identification of areas where further management measures may be required.

The identification and mapping of ecological receptors was undertaken using the principles of the precautionary approach, with calculations being based on a conservative proposal footprint that will be subject to further refinement/amendment during detailed design. Therefore, the assessment of potential impacts is likely to reflect the maximum extent associated with the proposal; however, the significance ratings of most potential impacts identified in Section 11.8 will be reduced after the implementation of mitigation measures, including avoidance, minimisation and mitigation strategies. In addition, the implementation of the mitigation measures identified in Section 11.9 will considerably reduce the significance of those impacts potentially resulting from the proposal's activities.

Terrestrial and aquatic ecological receptors will be avoided where practicable and potential impacts will be minimised and mitigated to the greatest extent practical; however, in some instances, the magnitude and significance ratings will remain unchanged following the implementation of the mitigation measures. Nevertheless, in many instances, a reduction in the magnitude of impacts will result in a reduction of impact significance following the application of mitigation measures.

There is the potential for some proposal activities to have a cumulative, irreversible and/or permanent impact on some terrestrial and aquatic ecological receptors, even after the implementation of all mitigation measures, including rehabilitation. Specific activities include site preparation (i.e. vegetation clearing) and civil works (i.e. cutting construction), having residual impacts on ecological receptors such as Brigalow TEC, Poplar Box grassy woodlands on alluvial plains TEC, Blue grass (*Dichanthium setosum*), painted honeyeater (*Grantiella picta*) and koala (*Phascolarctos cinereus*). In these cases, the residual impact will require environmental offsets, should the residual impact be considered significant in accordance with the relevant state and/or Australian Government guidelines/policies.

Post EIS and during the detailed design stage of the proposal, offsets will be delivered to offset residual adverse impacts to significant MNES and MSES ecological receptors. An offset will be required for ecological receptors that experience a significant residual adverse impact that may include areas containing habitat for EPBC Act-listed species and EPBC Act listed TECs (refer Table 11.19).

Further information related to the initial quantum of potential impacts to Australian Government and state-based biodiversity issues and associated offsets is provided separately in the following sections.

11.15.1 Matters of national environmental significance offset requirements

The EPBC Act Offsets Policy states: *‘Offsets provide environmental benefits to counterbalance the impacts that remain after avoidance and mitigation measures. These remaining, unavoidable impacts are termed “residual impacts”. Offsets will be required to compensate for the significant adverse residual impacts on MNES as a result of the proposal.*

‘A “significant impact” is defined as “an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends on the sensitivity, value and quality of the environment which is impacted and on the intensity, duration, magnitude and geographic extent of the impacts”’ (DotE, 2013).

For the purposes of meeting its MNES offset obligation, ARTC proposed to provide strategic offsets that provide habitat for MNES that are expected to be subject to significant adverse residual impacts as a result of the proposal (refer Section 11.12 and Table 11.19). Offsets for MNES’ ecological receptors also assessed under the BAM will be provided in accordance with the BAM (refer Section 11.11.1 and Table 11.18). Three species, the curlew sandpiper (*Calidris ferruginea*), Dunmall’s snake (*Furina dunmalli*), and red goshawk (*Erythrotriorchis radiatus*), were not assessed under the BAM and may require offsets as required under the EPBC Act.

11.15.2 Biodiversity credit report

ARTC has, where possible, altered the proposal to avoid and minimise ecological impacts in the proposal planning phase as required under the BAM, and a range of impact mitigation strategies have been included in the proposal to mitigate the impact on ecological receptors (refer Appendix B: Biodiversity Technical Report). The proposal and its assessment is therefore consistent with the BAM. This includes further potential to reduce the impact footprint where possible during the detailed design phase.

Full credit calculator reports are included in Appendix B: Biodiversity Technical Report.

Together, ecosystem credits, species credits and paddock tree credits are referred to as ‘biodiversity credits’. Table 11.22 provides a summary of the ecosystem and species credits that require offsetting as a result of work that is within and relating to the alignment.

Table 11.23 provides a summary of the ecosystem and species credits that required offsetting as a result of works within and relating to the borrow pits. Table 11.24 provides a summary of all ecosystem, species and paddock tree credits that require retirement as a result of this proposal. For the purposes of segmenting the delivery of required credits, the total credits required for each segment of the proposal is provided along with the area of impacts to native and non-native vegetation (refer Table 11.25).

TABLE 11.22 ECOSYSTEM, SPECIES AND Paddock Tree CREDITS GENERATED WITHIN THE ALIGNMENT

IBRA Sub region	Ecosystem-credits	Species-credits	Paddock Tree credits	Total credits
Northern Basalts	2,590	23,168	1	25,759
Northern Outwash	1,059	6,654	0	7,713
Castlereagh–Barwon	4,106	24,514	1	28,621
TOTAL Alignment	7,755	54,426	2	62,093

TABLE 11.23 ECOSYSTEM, SPECIES CREDITS GENERATED WITHIN THE BORROW PITS

Borrow pit and IBRA Sub region	Ecosystem credits	Species credits	Total credits
Northern Basalts			
BP8	787	7,673	8,460
BP9	1,427	13,361	14,788
BP11	520	3,350	3,870
BP25	72	627	699
BP1	126	126	252
NB total	2,932	25,137	28,069
Northern Outwash			
BP5	293	1,128	1,421
BP7	1,011	6,212	7,223
BP13	36	49	85
BP26	129	818	947
JJFV2	223	1,415	1,638
NO total	1,692	9,622	11,314
TOTAL Borrow Pits	4,624	34,759	39,383

TABLE 11.24 TOTAL OF ALL ECOSYSTEM AND SPECIES CREDITS GENERATED FOR THE PROPOSAL

IBRA Sub region	Ecosystem credits	Species credits	Paddock tree credits	Total credits
Northern Basalts	5,522	48,305	1	53,828
Northern Outwash	2,751	16,186	0	19,027
Castlereagh–Barwon	4,106	24,514	1	28,621
Combined impacts	12,379	89,005	2	101,476

TABLE 11.25 IMPACTS AND BAM CREDITS REQUIRED FOR EACH SEGMENT OF THE PROPOSAL

Segments	Native vegetation impacted (ha)	Non-native vegetation impacted (ha)	Total area impacted (ha)	Credits required (ecosystem and species)
Alignment	326.8	161.7	488.5	62,093
Borrow Pit 1	4.6	0.6	5.2	252
Borrow Pit 2	18.7	NA	18.7	1,638
Borrow Pit 4	0	10	10	0
Borrow Pit 5	20.1	7.7	27.8	1,421
Borrow Pit 7	47.3	16.9	64.2	7,223
Borrow Pit 8	21.1	2.8	23.9	8,460
Borrow Pit 9	50.1	4.7	554.8	14,788
Borrow Pit 11	19.4	3.2	22.6	3,870
Borrow Pit 13	2.5	16.4	18.9	85
Borrow Pit 25	6.0	19.7	25.7	699
Borrow Pit 26	5.3	3.0	8.3	947
Total	521.9	246.7	1,268.65	101,476

The information above assumes the presence of all ecosystem and species credit species that have not undergone targeted survey within BAM specified months. The exceptions to this are shrub sida, Yetman wattle, Sloane's froglet, squatter pigeon and those outlined Appendix B: Biodiversity Technical Report.

As detailed in Table 11.22, Table 11.23 and Table 11.24, a total of 7,755 ecosystem credits, 54,336 species credits and two paddock tree credits are required to offset the direct impacts of the alignment and 4,624 ecosystem credits, 34,759 species credits are required for the combined borrow pits.

Total credits of 12,379 for ecosystem impacts, 89,095 for species credit species impacts and two credits for paddock trees will be required should all aspects of the proposal proceed. The above credit numbers assume that all borrow pits will be used; however, this is unlikely to eventuate. Individual borrow pits have been assessed as separate areas in order to facilitate segmented offsetting if and when those areas are to be used. The number of credits required (i.e. biodiversity impacts) will be considered during the final selection of borrow pit sites. ARTC commits to the retirement of credits in accordance with the BAM guidelines.

11.15.3 State offsets obligations

The current bilateral agreement between the Australian Government and NSW relating to environmental assessment allows the Australian Government Minister for the Environment to rely on specified environmental impact assessment processes of the State of NSW. The agreement was made before the BC Act and does not refer to the *Biodiversity Offset Scheme* (BOS) or BAM. A draft bilateral agreement is currently under review and provides for accreditation of NSW processes for approval of proposed actions that would otherwise be assessed by the Australian Government for approval under the EPBC Act.

The Australian Government intends to endorse NSW's new BOS, which includes the BAM, the offset rules, the *Biodiversity Conservation Regulation 2017* and payments to the Biodiversity Conservation Trust.

A joint Australian and NSW Government review in 2020 will assess the effectiveness of NSW offset approaches in ensuring long-term environmental outcomes for relevant MNES.

While offset obligations can be calculated in BAM credits for EPBC Act projects, the Australian Government may not accept the specific application of the offset rules for projects approved before Amending Agreement No. 1 is signed. The Australian Government Minister, or a delegate, will determine this on a case-by-case basis.

Under the BAM, each borrow pit has been assessed as an individual proposal but been reported as part of the whole assessment. This will enable segmented offsetting for those borrow pits that will be developed only.

Offsets required for impacts to aquatic ecological receptors listed under provisions of the FM Act will be calculated following the detailed design phase.

ARTC proposes to provide its offset obligation post-EIS, following the detailed design and before the construction phases. Detailed offset will be in multiple segments to align with the schedule of disturbance. The rail alignment and associated construction infrastructure (such as individual borrow pits) will be subject to retiring 'biodiversity credits' prior to the commencement of each segment of the proposal independently.

11.16 Conclusions

The subject land provides suitable habitat for a number of TECs and threatened species listed under the provisions of the EPBC Act and/or the BC Act. The subject land contains a suite of other ecological receptors including habitat connectivity, wetlands and waterways. No protected or sensitive lands were identified within the study area.

The subject land was assessed under the BAM for all BC Act listed ecological receptors and under the EPBC Act requirements, where those species and or communities were not captured under BAM. FM Act threatened species, populations and ecological communities were also considered and assessed.

One hundred and twenty-six (126) ecological receptors were identified within the subject land for the purposes of this assessment. These varied from broad-scale ecological receptors, such as landscape features, down to finer species-scale ecological receptors, including TECs (six TECs listed under the BC Act and/or EPBC Acts) and habitat for threatened flora and fauna species (16 flora species and 74 fauna species). These ecological receptors were grouped into high-, moderate- and low-sensitivity categories based on factors including conservation status, exposure to threatening processes, resilience and representation in the broader landscape.

The construction and operation of the proposal has the potential to impact on ecological receptors through the following potential impacts:

- ▶ Habitat loss and degradation from vegetation clearing/removal
- ▶ Fauna species injury or mortality
- ▶ Reduction in biological viability of soil to support growth due to soil compaction
- ▶ Displacement of flora and fauna species by invasion of weed and pest species
- ▶ Reduction in the connectivity of biodiversity corridors
- ▶ Edge effects
- ▶ Habitat fragmentation
- ▶ Barrier effects
- ▶ Noise, dust and light impacts
- ▶ Increase in litter (waste)
- ▶ Erosion and sedimentation
- ▶ Disturbance to specialists breeding and foraging habitat
- ▶ Trampling of threatened species
- ▶ Fallen timber and bush rock collection and removal
- ▶ Fertiliser drift
- ▶ Increased fire risk
- ▶ Aquatic habitat degradation.

The nature of each unmitigated potential impact was considered in relation to the identified ecological receptors to derive an initial assessment of impact significance for the proposal. This was determined by assigning sensitivity and magnitude ratings that were then allocated a significance rating through the significance assessment matrix. The potential impacts on the ecological receptors were assigned a major, high, moderate, low or negligible rating.

The proposed avoidance and mitigation measures for the proposal were identified in order to reduce the significance of the potential impacts on the ecological receptors. The mitigation strategies associated with the proposal are presented in Section 11.9. Following the application of the mitigation hierarchy (i.e. avoid, minimise, mitigate), which included a range of mitigation measures and management plans, the residual impacts to the identified ecological receptors were generally reduced. Aside from avoidance and impact minimisation, the application of additional mitigation measures was not likely to significantly reduce impacts associated with the loss of vegetation through clearing/removal, resulting in an adverse residual impact to each of the terrestrial ecological receptors.

Impact assessment under the BAM identified serious and irreversible impacts (SAIL) for one PCT and two species credit species. Final targeted surveys are yet to be completed and predicted threatened species and communities are assumed to be present, based on existing knowledge of the subject land and BAM requirements. Through the alternative assessment methodology, significant impacts for MNES are predicted for four TECs, four threatened flora species and 16 threatened fauna species. The PCT and threatened species identified under BAM as SAIL are:

- ▶ PCT35 – Brigalow–Belah open forest/woodlands known to occur
- ▶ Pale imperial hairstreak (*Jalmenus eubulus*)
- ▶ Braid fern (*Platyzoma microphyllum*).

The greatest potential predicted impacts (direct disturbance) as a result of the proposal may be on the following ecological receptors:

- ▶ Painted honeyeater (*Grantiella picta*)—310.93 ha
- ▶ Koala (*Phascolarctos cinereus*)—323.12 ha
- ▶ Corben's long-eared bat (*Nyctophilus corbeni*)—282.74 ha
- ▶ Bluegrass (*Dichanthium setosum*)—282.22
- ▶ Grey-headed flying-fox (*Pteropus poliocephalus*)—277.87 ha.

In addition to habitat loss, the unmitigated impacts of fauna injury and mortality and a reduction in the connectivity of biological corridors are predicted to impact ecological receptors including threatened fauna. Threatened fauna species considered most likely to be adversely affected by an increase in mortality and a reduction in landscape connectivity as a result of the proposal include:

- ▶ Squirrel glider (*Petaurus norfolcensis*)
- ▶ Koala (*Phascolarctos cinereus*).

Processing of MNES using the adverse impact assessment methodology reduced the identified levels of potential impacts to those that are considered to constitute a significant adverse residual impact in accordance with the Australian Government significant impact guidelines. The significant adverse residual impact for the MNES noted above are:

- ▶ Painted honeyeater (*Grantiella picta*)—292.73 ha
- ▶ Koala (*Phascolarctos cinereus*)—285.47 ha
- ▶ Corben's long-eared bat (*Nyctophilus corbeni*)—280.36 ha (0.84 per cent reduction)
- ▶ Bluegrass (*Dichanthium setosum*)—237.1 ha (15.99 per cent reduction)
- ▶ Grey-headed flying-fox (*Pteropus poliocephalus*)—263.93 ha.

During Phase 2 of the proposal (detailed design, post-EIS), sensitive ecological receptors identified during the EIS will be subject to further investigation, so as to more accurately determine the magnitude of the significant adverse impacts upon the identified ecological receptors. The specific mitigation measures will then be applied to ensure that the significance ratings of any potential impacts are classified as low as reasonably practicable, and the more significant adverse impacts are offset. The findings of these investigations will be used to refine the BAM Calculator data for the proposal. The current requirements are 101,476 credits for BC Act offsets and like-for-like offsets for EPBC Act offsets.

There is the potential for some proposal activities to have irreversible and/or permanent impact on some ecological receptors, even after the implementation of all mitigation measures. In these cases, the compensation for the residual impact will need to occur. Compensation in the form of biodiversity credit retirements will be required. This Biodiversity Development Assessment Report forms the basis of the environmental offset plan for the proposal, which will be prepared in consultation with the relevant state and Australian Government departments and will comply with the relevant offsets policies.